The N. C. Agricultural Experiment Station 1905—1906

TWENTY-NINTH ANNUAL REPORT

OF THE

NORTH CAROLINA

Agricultural Experiment Station

OF THE

COLLEGE OF AGRICULTURE AND MECHANIC ARTS

FOR THE

Year Ending June 30, 1906.

INCLUDING BULLETINS Nos. 193, 194.

Raleigh, North Carolina.

RALEIGH:
PRESSES OF EDWARDS & BROUGHTON PRINTING CO.
1907.

N. C. COLLEGE OF AGRICULTURE AND MECHANIC ARTS.

THE NORTH CAROLINA
AGRICULTURAL EXPERIMENT STATION

UNDER THE CONTROL OF THE

TRUSTEES OF THE A. AND M. COLLEGE.

S. L. PATTERSON, *ex officio* Chairman, Raleigh.

J. M. FOREHAND.....Tyner	A. T. MCCALLUM.....Red Springs
J. B. STOKES.....Windsor	J. P. MCRAE.....Laurinburg
WM. DUNN.....New Bern	R. L. DOUGHTON.....Laurel Springs
C. N. ALLEN.....Auburn	W. A. GRAHAM.....Machpelah.
R. W. SCOTT.....Melville	A. CANNON.....Horse Shoe

STATION STAFF.

GEO. T. WINSTON, LL. D., President of the College.

B. W. KILGORE.....Director.
W. A. WITHERS.....Chemist.
C. W. BURKETT.....Agriculturist.
TAIT BUTLER.....Veterinarian.
F. L. STEVENS.....Biologist.
H. H. HUME.....Horticulturist.
J. S. JEFFREY.....Poultryman.
R. S. WOGLUM.....Acting Entomologist.
WILLIAM KERR.....Assistant in Field Experiments.
J. C. KENDALL.....Assistant Dairy Husbandry.
O. L. BAGLEY.....Assistant Chemist.
R. H. HARPER.....Assistant Chemist.
F. C. REIMER.....Assistant Horticulturist.
A. F. BOWEN.....Bursar.

The Director's office is in the Agricultural Building, Raleigh; the experiment grounds and laboratories being at the Agricultural College just west of town and on the street car line.

Visitors will be welcome at all times and will be given every opportunity to inspect the work of the Station. Bulletins and reports are mailed free to all residents of the State upon application.

Address all communications to

THE AGRICULTURAL EXPERIMENT STATION,
RALEIGH, N. C.

TABLE OF CONTENTS.

LETTER OF TRANSMITTAL.

Raleigh, N. C., June 30, 1906.

To His Excellency, Robert B. Glenn,

Governor of North Carolina:

Sir:—I have the honor to transmit herewith the report of the operations of the Agricultural Experiment Station of the North Carolina College of Agriculture and Mechanic Arts, for the year beginning July 1, 1905, and ending June 30, 1906.

Very respectfully,

S. L. Patterson,
Chairman Board of Trustees.

LETTER OF SUBMITTAL.

The North Carolina
Agricultural Experiment Station,
Office of the Director,
Raleigh, N. C., June 30, 1906.

Hon. S. L. Patterson, *Chairman Board of Trustees.*

Sir:—I have the honor to transmit herewith the report of the operations of the North Carolina Agricultural Experiment Station of the North Carolina College of Agriculture and Mechanic Arts, for the year ending June 30, 1906.

Trusting that this report will prove satisfactory, I am,

Very respectfully,

B. W. Kilgore,
Director.

TWENTY-NINTH ANNUAL REPORT

OF THE DIRECTOR OF THE

N. C. AGRICULTURAL EXPERIMENT STATION

For the Year Ending June 30, 1906.

BY THE DIRECTOR.

This report covers the work of the Station from July 1, 1905, to June 30, 1906.

THE ADAMS FUND.

An Act was passed by the Congress of the United States and approved by the President on March 16, 1906, known as the Adams Act, and is entitled "An Act to Provide for an Increased Annual Appropriation for Agricultural Experiment Stations and Regulating the Expenditure Thereof." The amount of this appropriation was five thousand dollars for 1906, which is to increase two thousand dollars annually until a total of fifteen thousand dollars is reached, which will give, under the two experiment station acts of Congress, namely, the Hatch and Adams Acts, a total of thirty thousand dollars for use in conducting agricultural experiment stations in the several states and territories. This Act is as follows:

ADAMS ACT.

"An Act to provide for an increased annual appropriation for agricultural experiment stations and regulating the expenditure thereof.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That there shall be, and hereby is, annually appropriated, out of any money in the Treasury not otherwise appropriated, to be paid as hereinafter provided, to each State and territory for the more complete endowment and maintenance of agricultural experiment stations now established or which may hereafter be established in accordance with the act of Congress approved March second, eighteen hundred and eighty-seven, the sum of five thousand dollars, in addition to the sum named in said act for the year ending June thirtieth, nineteen hundred and six, and an annual increase of the amount of such appropriation thereafter for five years by an additional sum of two thousand dollars over the preceding year, and the annual amount to be paid thereafter to each State and territory shall be thirty thousand dollars, to be applied only to paying the necessary expenses of conducting original researches or experiments bearing directly on the agricultural industry of the United States, having due regard to the varying conditions and needs of the respective States or territories.

Sec. 2. That the sums hereby appropriated to the States and territories for the further endowment and support of agricultural experiment stations shall be annually paid in equal quarterly payments on the first day of January, April, July and October of each year by the Secretary of the Treasury, upon the warrant of the Secretary of Agriculture, out of the Treasury of the United States, to the treasurer or other officer duly appointed by the governing boards of said experiment stations to receive the same, and such officers shall be required to report to the Secretary of Agriculture on or before the first day of September of each year, a detailed statement of the amount so received and of its disbursement on

schedules prescribed by the Secretary of Agriculture. The grants of money authorized by this act are made subject to legislative assent of the several States and territories to the purpose of said grants. *Provided*, that payment of such installments of the appropriation herein made as shall become due to any State or territory before the adjournment of the regular session of Legislature meeting next after the passage of this act shall be made upon the assent of the Governor thereof, duly certified by the Secretary of the Treasury.

Sec. 3. That if any portion of the moneys received by the designated officer of any State or territory for the further and more complete endowment, support and maintenance of agricultural experiment stations as provided in this act shall by any action or contingency be diminished or lost or be misapplied, it shall be replaced by said State or territory to which it belongs, and until so replaced no subsequent appropriation shall be apportioned or paid to such State or territory; and no portion of said moneys exceeding five per centum of each annual appropriation shall be applied, directly or indirectly, under any pretense whatever, to the purchase, erection, preservation, or repair of any building or buildings, or to the purchase or rental of land. It shall be the duty of each of said stations annually, on or before the first day of February, to make to the Governor of the State or territory in which it is located a full and detailed report of its operations, including a statement of receipts and expenditures, a copy of which report shall be sent to each of said stations, to the Secretary of Agriculture, and to the Secretary of the treasury of the United States.

Sec. 4. That on or before the first day of July in each year after the passage of this act the Secretary of Agriculture shall ascertain and certify to the Secretary of the Treasury as to each State and territory whether it is complying with the provisions of this act and is entitled to receive its share of the annual appropriation for agricultural experiment stations under this act and the amount which thereupon each is entitled, respectively, to receive. If the Secretary of Agriculture shall withhold a certificate from any State or territory of its appropriation, the facts and reasons therefor shall be reported to the President and the amount involved shall be kept separate in the Treasury until the close of the next Congress in order that the State or territory may, if it shall so desire, appeal to Congress from the determination of the Secretary of Agriculture. If the next Congress shall not direct such sum to be paid it shall be covered into the Treasury; and the Secretary of Agriculture is hereby charged with the proper administration of this law.

Sec. 5. That the Secretary of Agriculture shall make an annual report to Congress on the receipts and expenditures and work of the agricultural experiment stations in all of the States and territories, and also whether the appropriation of any State or territory has been withheld, and if so, the reason therefor.

Sec. 6. That Congress may at any time amend, suspend or repeal any or all of the provisions of this act.

Approved, March 16, 1906.

The Secretary of Agriculture is charged with the administration of this law, which provides that the funds are "to be applied only to paying the necessary expenses of conducting original researches or experiments bearing directly on the agricultural industry of the United States."

The policy of the Secretary of Agriculture with reference to the administration of the Act is outlined in the following letter:

"UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
WASHINGTON, D. C., March 20, 1906.

To the Directors of the Agricultural Experiment Stations.

Congress having passed the Adams Bill, which provides for an increased annual appropriation for agricultural experiment stations, and the measure having been

approved by the President, it becomes my duty to undertake the administration of this law.

In order to facilitate the prompt and effective organization of work under this act, and to provide for a proper accounting for expenditures authorized by said act, I have prescribed a schedule for the report of such expenditures for the fiscal year ending June 30, 1906, and until further orders, in accordance with section 2 of said act. Copies of this schedule will be sent later.

The Director of the Office of Experiment Stations is hereby designated my representative in all matters relating to the business of this Department in connection with the administration of this law, and the Office of Experiment Stations will aid in promoting effective work under this act in the same general way as it has heretofore in relation to the Hatch Act.

Under the terms of the act it will be necessary that a separate account of the Adams fund shall be kept at each station, which should be open at all times to the inspection of the Director of the Office of Experiment Stations, or his accredited representative.

In the interpretation of this act and the examination of the work and expenditures of the stations under it, I have instructed the Director of the Office of Experiment Stations to be guided by the following principles:

The Adams fund is 'to be applied only to paying the necessary expenses of conducting original researches or experiments bearing directly on the agricultural industry of the United States.' It is for the 'more complete endowment and maintenance' of the experiment stations, presupposing the provision of a working plant and administrative officers. Accordingly, expenses for administration, care of buildings and grounds, insurance, office furniture and fittings, general maintenance of the station farm and animals, verification and demonstration experiments, compilations, farmers' institute work, traveling, except as is immediately connected with original researches in progress under this act, and other general expenses for the maintenance of the experiment stations, are not to be charged to this fund. The act makes no provision for printing or for the distribution of publications, which should be charged to other funds.

In order that there may be no doubt as to the disposal of the Adams fund, each station should outline a definite programme of experimental work to which it will devote this fund, and expenses for other work should not be charged to it. The work contemplated by this act will, as a rule, necessarily cover more than one year, and changes in the programme once adopted should not be made until the problems under investigation have been solved, or their solution definitely shown to be impracticable. This will give ample opportunity for making plans for winding up any particular piece of work and beginning another with such deliberation as will provide for the suitable and economical expenditure of this fund without resort to doubtful expedients or expenditures. It is much to be desired that this fund shall be a strong incentive to the careful choice of problems to be investigated, thorough and exhaustive work in their solution, and the securing of permanent and far-reaching results on which can be safely based demonstration and verification experiments leading to the general improvement of farm practice in many particulars.

No change will be made in the attitude of this Department toward expenditures under the Hatch Act. The Hatch fund should be as carefully guarded as ever, and be devoted to substantial experimental work and the printing and dissemination of the results of such work.

The increased liberality of the Federal government in providing for the endowment of research and experimentation in agriculture should be a further incentive to the States and local communities to supplement these funds for the extension of demonstration experiments, farmers' institutes, agricultural colleges, schools, and courses of instruction, and the general education of the rural communities along industrial lines, in order that the masses of our farmers may be so educated from early youth that they will appreciate the benefits of original research and experimentation as applied to agricultural problems, and be able to appropriate in the most effective manner for their own benefit and the general welfare of the nation whatever practical results are obtained from the work of the agricultural experiment stations.

Very truly yours,

JAMES WILSON,
Secretary."

CHANGES IN STATION STAFF.

Prof. W. F. Massey, who has been long connected with the Station as Horticulturist, resigned in December to devote his entire time and energies to editorial work. His place was filled by the election of Prof. H. H. Hume; Mr. F. C. Reimer was added to the staff as assistant horticulturist. Dr. Charles Walker was transferred from the Station to the College, and his work has been done by Messrs. R. H. Harper and O. L. Bagley.

WORK IN THE AGRICULTURAL DIVISION.

The experiments which have been in operation for the past four years with cotton and corn in testing varieties, fertilizer requirements, and culture methods, have been continued in order to obtain further data on these subjects. Similar experiments are in progress with cow peas and soja beans.

A considerable number of plats have been devoted to alfalfa, with a view of determining the best time, methods and amount of seeding, inoculation, fertilization, etc.

Plat experiments with grasses and other forage crops are also being continued, in order to collect further data regarding the production of these crops. Some work has been done in dairying and the feeding experiments with horses and mules with our home-grown feeds have been continued.

WORK IN THE CHEMICAL DIVISION.

The Chemical Division has continued its study of nitrogenous fertilizer materials, their changes in soil through the agency of bacteria, and the effect of various changes on the distribution and growth of soil bacteria affecting nitrogen-furnishing materials. It has also been necessary to study methods in connection with these various lines of work.

WORK IN THE BIOLOGICAL DIVISION.

In the work of the Biological Division in the study of plant diseases and methods of combatting these, tests have been continued at Auburn by the Station in co-operation with the Bureau of Plant Industry of the United States Department of Agriculture, with the view of developing a variety of watermelon which will resist the watermelon wilt. The present results are encouraging.

The Granville tobacco wilt work is also being continued, the tests including a large number of varieties, together with the study of possible methods of overcoming the disease.

In like manner a large number of varieties of sweet potatoes are being grown in Perquimans County, in the hope of getting a variety which will withstand the wilt disease which is affecting this crop.

Several co-operative spraying experiments are being made in dif-

ferent parts of the trucking belt on cucumbers, Irish potatoes, cantaloupes, tomatoes and similar crops, for the purpose of testing methods of preventing or reducing damages to these crops by various fungous diseases.

WORK IN THE VETERINARY DIVISION.

The State Department of Agriculture furnishes the main support to the veterinary work, the Station only paying a part of the salary of the Veterinarian.

In addition to dealing with the various diseases of domestic animals and giving general encouragement to the live stock interests of the State, the Veterinarian has devoted special efforts to the development of methods for the extermination of the cattle fever tick. In 1902 only sixteen of the western counties of the State were exempt from the Federal cattle quarantine restrictions. At the close of 1906 thirty-six counties have been practically freed from this pest. This shows that decided progress has been made in this work. With the aid of the National Government the eradication of the tick in the State in the future should be and will be more rapid.

WORK IN THE POULTRY DIVISION.

One additional building was added to the poultry plant during the past year for use in keeping male birds when not in use in the breeding season. The quality and healthfulness of the stock is greatly improved, as has general interest in poultry production in the State. This is shown by the increase in correspondence and interest at Farmers' Institutes which the Poultryman has attended.

Experiments are being conducted in pedigreed breeding for egg production; dry feeding from hoppers in comparison with mash feeding for laying hens; hopper feeding for brooder-raised chicks; test of the value of green feed in winter, both as to the number of eggs laid and the percentage of fertility; and the number of chicks hatched in comparison of different methods of cooling and turning eggs in incubator; and increase of egg production from different breeds.

WORK IN THE ENTOMOLOGICAL DIVISION.

With the exception of a part of the salary of the Entomologist the entomological work is provided for by the State Department of Agriculture. During the past year the main efforts have been directed toward methods for the eradication and control of the San Jose' scale, testing of comparative means of combatting the curculio of the peach, and some investigations as to the present conditions of bee-keeping and bee culture, with the view of inaugurating some experiments in this line.

PUBLICATIONS.

Bulletins have been issued as follows:

No. 193—Spraying Mixtures and Machinery, by F. L. Stevens and R. S. Woglum.

No. 194—Mulberries, by H. H. Hume and F. C. Reimer.

The reports of the heads of the several divisions of the Station and financial statement follow:

REPORT OF THE AGRICULTURAL DIVISION.

PROF. B. W. KILGORE, *Director.*

DEAR SIR:—The work of the Agricultural Division, during the past year, has been along similar lines as outlined in previous reports. The major part of this work is grouped under Plat Experiments that include the important phases of field work in the State. In planning these experiments the aim has been to study fundamental principles rather than immediate results. The following field crops are included in this division of the work:

(1) *Corn.*—Several phases of corn production are being studied, including fertilization, rotations of various crops in relation to corn production, varieties of corn best suited to State conditions, methods of culture and selection of seed. This work has been in progress for the past four years and is designed to cover an extended period that definite conclusions may be drawn. It will follow that additional plats will be necessary for this work as the results now indicate.

(2) *Cotton experiments.*—Involving a study of fertilization, rotations in relation to cotton production, varieties of cotton, methods of culture, etc., are included in the plat work devoted to this important field crop. Like corn these tests have been conducted for a period of four years and should be the beginning of a series of more extended tests.

(3) *Cow Peas.*—Included in this study are varieties, time of planting, fertilization and methods of culture. This work now covering a period of four years is to be continued.

(4) *Soja Beans.*—Similar tests as outlined for cow peas are being conducted with this crop.

(5) *Alfalfa.*—Sixty field plats have been used in the tests with alfalfa where methods of seeding, methods of inoculation and fertilization are studied. Twenty additional plats have been used for this work during the past year and the importance of the work from results already secured indicate that a more extended study should be given this subject.

(8) *Forage Crops and Grasses.*—The leading and important forage crops of the country have received attention by this division during the past five years. The object has been to ascertain times best suited to State conditions. This work should be continued indefinitely that every phase may be carefully studied.

DAIRY PRACTICE.

Dairying is assuming larger proportions than formerly in this State, consequently this division of the Station is giving such attention as possible to its needs. The Station work includes:

(a) Comparison of available feeding stuffs.
(b) Productive capacity of individual cows.
(c) External form as an index of dairy quality.
(d) Cost of producing milk, cream and butter under State conditions.
(e) Best means of building up dairy herds.

Other lines of dairy work, particularly along lines of dairy manufacture, are being outlined for subsequent work for the coming year.

HORSES AND MULES.

The feeding of horses and mules with home-raised feeding stuffs is being continued. College teams are used for this purpose. The object in these tests is to study the efficiency of home-grown feeds and to study the effect upon work produced.

Very truly yours,

C. W. Burkett,
Agriculturist.

REPORT OF THE CHEMICAL DIVISION.

PROF. B. W. KILGORE, *Director.*

DEAR SIR:—During the past year ended June 30 the Chemical Division continued its study of the changes which took place in nitrogen, when added to the soil in different forms of combination. Some of the more important results are:

1. *Modification of form in which nitrogen was added.*—Heretofore the two nitrogenous materials supplied to the soil were ammonium sulphate and cottonseed meal, two substances fairly representative of the usual inorganic and organic nitrogenous fertilizers. During the past year asparagin was substituted for cottonseed meal for three reasons: (a) because with cottonseed meal containing phosphoric acid and potash which furnish food for the nitrifying organisms and unless correction is made for the effect of these elements, the results with other nitrogenous material are not comparative; (b) because the nitrogenous material in cottonseed meal is not a definite chemical compound, and (c) because asparagin is a definite chemical compound, not very difficult to obtain in a pure form and not subject to change when kept stored. In addition to asparagin and ammonium sulphate, the salts sodium nitrite and sodium nitrate were used, and in consequence the four nitrogenous materials supplied amide and amine nitrogen, ammoniacal nitrogen, nitrite nitrogen and nitrate nitrogen. It will probably be desirable in the near future to use also some of the albuminoids.

2. *Forms of nitrogen in the product.*—Heretofore only nitrates and nitrites were determined in the product. In addition to these the determinations of organic and ammoniacal nitrogen in the product have been made.

3. *Completeness of extraction by water and shaking.*—Samples of the soil used in the other work were sterilized and treated with different nitrogenous materials, immediately shaken in a shaking machine for four hours with the usual amount of water, filtered in the usual manner and the amount of nitrogen in the filtrate determined. It was found that the percentages given below were recovered in the filtrate:

Asparagin	88.60 per cent.
Ammonium sulphate	88.13 per cent.
Sodium nitrite	59.44 per cent.
Sodium nitrate	91.90 per cent.

This shows very good recovery in every case but nitrites.

4. *Source of inaccuracy in the Tiemann-Schulze method for determining nitrates and nitrites.*—It has been noted previously that the gas evolved by this method, which is supposed to be nitrogen dioxide, is not entirely soluble in a solution of ferrous sulphate,

there being amounts of residual gas varying from practically nothing to as much as five cubic centimeters. The method was carried through, omitting the addition of a nitrogenous compound and using simply distilled water, hydrochloric acid, or ferrous chloride, then two of these substances and then all three. At the end of the operation water, heated almost to the boiling point, was introduced to the flask and the gas washed out into an eudiometer. The amount of this gas was found to vary just as when the nitrogenous material had been added, showing that the gas was not liberated from the nitrogenous material, but consisted of air, which had leaked into the apparatus or which had been dissolved in one of the liquids introduced to the flask.

5. *Determination of nitrites.*—The method heretofore used by the this Division and the method of the Bureau of Soils were tested with solutions of known strength and found to be equally accurate, but as the final color produced by the Bureau method is pink instead of yellow it is more easily read and is probably more accurate with soil solutions which are slightly yellow. It has accordingly been substituted this year.

6. *Decolorization of solution.*—As the method of determining nitrites is colorimetric, it is necessary to clarify this solution. The Bureau of Soils uses pure carbon black for this purpose. This Division did not have any of this substance on hand, could obtain none from New York and there was not sufficient time for it to be imported. The results with lampblack, animal charcoal, ammonia, sodium carbonate and alum, each of which has been proposed, were compared. Lampblack, with the oil extracted by alcohol or gasoline, was satisfactory as was also the treatment with ammonia and alum together, there being an excess of alum. Both of these methods were tried with solutions of known strength. The treatment with the lampblack gave the most satisfactory results because it did not alter the volume of the solution. By allowing the solution to stand for awhile without other treatment a large part of the coloring matter settles out.

7. *Effect of time and season upon nitrifying organisms.*—In March, 1905, some samples of soil from Mr. Sloan's garden were placed in battery jars upon the roof and exposed to atmospheric conditions. Grass grew luxuriantly. When originally taken these samples had good nitrifying powers. The following results were obtained after some month's standing:

Nitrogenous Material Added.	Nitrites Formed.		Nitrates Formed.	
	Sept. 1905.	Feb. 1906.	Sept 1905	Feb. 1906.
	Per Cent.	*Per Cent.*	*Per Cent.*	*Per Cent.*
Blank	None	None.	2.20	None.
Asparagin	23.77	None.	4.21	None.
Ammonium sulphate	Trace.	None.	21.95	None.
Sodium nitrite	Omitted.	2.23	Omitted.	None.
Sodium nitrate	Omitted.	None.	Omitted.	45.58

This soil with or without added nitrogen produced no nitrates nor nitrites in February. As the amount of nitrogen which was recovered was considerably less than that added, there was evidently some change toward reduction, as nitrites and nitrates were formed in September and not in February following it would indicate that the organisms producing these changes were injured by the cold, compactness of the soil or the growth of grass.

8. *New organism.*—It is a matter of interest that in September this soil produced nitrites, but no nitrates from asparagin, and nitrates, but no nitrites from ammonium sulphate. This would confirm conclusions heretofore reached by the Division that the oxidation of organic nitrogen and of ammoniacal nitrogen is accomplished by different organisms. These results suggest the desirability of further work along this line.

9. *Rapidity of natural inoculation.*—A sample of soil from Mr. Sloan's garden was sterilized and placed upon the roof near the samples from the same garden which had not been sterilized. In January, 1906, a sample was taken, various nitrogenous materials were added and after standing for four weeks nitrites and nitrates were determined with the following results:

Nitrogenous Material Added.	Nitrites.	Nitrates.
	Per Cent	*Per Cent.*
Blank	None.	None
Asparagin	16.84	None.
Ammonium sulphate	15.55	1.78
Sodium nitrite	41.28	None.
Sodium nitrate	6.74	76.66

This shows that the nitrogen-oxidizing organisms are readily transferred from one soil to another. It is desirable to test this point further by making determinations at brief intervals and by placing the sterilized samples at a greater distance from the inoculating soil.

10. *Sensibility of organisms.*—The results noted above show that the nitrate-forming organism which was in the soil in September did not appear to be present in February in the natural or in the previ-

ously sterilized soil. As a smaller part of the nitrogen is recovered in the winter in the form of nitrites from the soil containing grass than from the previously sterilized soil, it would indicate that the nitrite-forming organism while more resistant than the nitrate-forming, is less resistant than the reducing organism.

11. *The adaptability of one soil for bacteria of another.* The soil from the experimental plats produced no nitrates nor nitrites from asparagin or ammonium sulphate, when previously sterilized and inoculated with soil from Mr. Park's garden.

12. *Effect upon nitrifying power of previous treatment with solvents and previous ignition.* This was tried with soil from the experimental plats inoculated with soil from Mr. Park's garden, but as the soil itself gave no nitrifation, the results were negative of course. It was not anticipated that the natural soil would give negative results, as it was fairly productive. The solvents used were fifth, fiftieth and two hundredth normal hydrochloric acid. The acid was washed out with water as completely as possible and any remaining acidity overcome by the addition of a solution of calcium acid carbonate. This will be continued with other soils.

13. *Effect of the addition of various fertilizing materials to the soil upon its nitrifying power.*—The materials used were sodium hydrogen phosphate, potassium sulphate and calcium carbonate singly and in combination. This series is in progress.

FUTURE WORK.

During the coming year we wish to follow up some of the points suggested above under the different headings, studying different soils to ascertain the food best suited to each soil, the effect of various solvents upon plant food, the rapidity of natural inoculation and the adaptability of one soil for the growth of the organisms of another.

The work of this Division in the past has indicated that the soil contains an organism capable of oxidizing organic nitrogen without previously passing through the form of ammonia. It is desirable to separate this organism if in existence, and for this purpose I would respectfully recommend the appointment of Mr. J. C. Temple, a recent graduate in agriculture from this college, who has been pursuing advanced studies during the past year in chemistry and bacteriology.

Mr. Harper and Mr. Bagley wish to sever their connection with the Station, much to my regret. They have both been satisfactory workers. I would respectfully recommend the appointment of Dr. Wm. A. Syme, an alumnus of this college, who has just completed his postgraduate studies at the Johns Hopkins University.

Nitrogen is the most expensive element which the farmer purchases and the element susceptible of the most changes. It is to be hoped that our results will continue to throw light upon some of the changes which take place in its combinations and upon some of the conditions under which these changes take place in the soil.

Very respectfully, W. A. WITHERS, *Chemist.*

REPORT OF THE BIOLOGICAL DIVISION.

MR. B. W. KILGORE, *Director.*

DEAR SIR:—I beg leave to submit a report of investigations of the fiscal year now closing:

Watermelon Wilt.—Co-operative work with the National Department of Agriculture has been continued at Auburn in the attempt to secure a variety of watermelon resistant to the watermelon wilt. Twenty hybrids were tested last year. Among these resistant varieties were many individuals which possessed, in addition to resistance, high commercial value. They were sweet, crisp, firm, solid, fine grained, with thin hard rind; in every way of the highest rank. Such edible melons possessing resistance were much more numerous this year than last, and it is hoped that succeeding years may lead to the fixation of some of these types so that they will come true to seed.

Truck Diseases.—In April a trip through the trucking region was made for the purpose of ascertaining what plant diseases were most destructive and to plan experiments looking to their control. The following co-operative experiments were arranged for. At LaGrange, experiments concerning spraying *Irish potatoes* to determine the value of spraying with the ordinary Bordeaux and the soda Bordeaux in comparison with no spraying at all. Also at LaGrange a similar experiment with *cucumbers.* At Newbern a similar experiment with *cucumbers.* At Mt. Olive a similar experiment with *cantaloupes.* At Rocky Point a similar experience with *cucumbers.* At Wilmington similar experiments with *Irish potatoes, cucumbers* and *tomatoes.* At Maxton similar experiments with *beans* and *cantaloupes.* At Fayetteville similar experiments with *Irish potatoes.* In all cases the crops mentioned suffer seriously by injury from fungi, and the experience in other States has been that the specific diseases here mentioned can be controlled by means which we are testing. It is hoped that these experiments may serve as object lessons as well as tests of efficiency of the remedy under conditions prevailing in North Carolina.

Tabacco Wilt.—Experiments have been continued at Creedmoor in testing different varieties of tobacco as regards their power to resist the Granville Tobacco Wilt. No variety has yet been found possessing resistance enough to warrant selection from it. A large number of new varieties, including varieties from Cuba, Brazil, Persia, China, and Japan are at hand and will be tested this year.

A canvass of the farm conditions in Granville County was made with the hope of throwing light upon the relation of this disease to crop rotation, soil, fertilizers, water, etc. Observations were made which will be the basis of future work.

Sweet Potato Wilt.—This disease destroys more than half the crop on farms in many portions of the State. All the varieties of sweet potatoes known, about twenty-seven in all, will be grown on affected soil in Perquimans County, with the hope of finding some variety more resistant to this disease than the varieties ordinarily grown.

Correspondence.—A large correspondence, chiefly concerning plant diseases has been conducted, and timely articles concerning plant diseases and their treatment have been prepared for local newspapers and agricultural papers.

Nature Study.—In every way possible efforts have been made to sustain and increase the interest of the teachers of the State in Nature Study. These efforts have consisted chiefly in writing articles for publication; in writing letters to the teachers of the State; and a bulletin for the State Department of Education.

Co-operative work on Plant Disease Survey.—In co-operation with the National Department of Agriculture an attempt has been made to secure by correspondence information, data, statistics, and specimens concerning the plant diseases of the State.

Student Investigation.—Under the guidance of the Station Botanist and Plant Pathologist, one of the students of the College has spent much time in investigating the bacteriology of manure, the number of bacteria, the kinds of bacteria, and their relation to its nitrogen content.

Respectfully submitted,

F. L. Stevens,

REPORT OF THE VETERINARY DIVISION.

MR. B. W. KILGORE, *Director.*

DEAR SIR:—The following report is respectfully submitted from the Veterinary Division:

Since my last report this Division has continued its experimental work in methods of tick (Boophilus annulatus) eradication. The results obtained and previously reported have attracted the attention of live stock sanitarians throughout the whole tick infested area of this country, and recognizing that no question involving the live stock interests of the South approaches in importance the eradication of the cattle fever tick, Congress has made an appropriation to enable the Federal Bureau of Animal Industry to co-operate with the several tick infested States in inaugurating this work, which is to eventually remove from the cattle industry of the South the most serious obstacle to its development. It is not immodest to state that this national interest and activity in the work of tick eradication is largely due to the successful pioneer work done in North Carolina.

Our work during the past year has served to confirm the opinion previously reported that the complete eradication of the cattle fever tick is entirely practicable in any given area or territory where the cattle can be controlled or where the "stock law" or "no fence law" is enforced. Not only is this true, but such eradication may be accomplished at a cost well within the loss occasioned by the presence of the ticks for the short period of one or two years.

Fig. 1.—Tick Fever Cattle Quarantine Line across North Carolina, 1902.

In 1902 only sixteen of the Western Counties of the State were free from the Federal cattle quarantine restriction (See Fig. 1, page

21). At the close of work for the season of 1906 thirty-six counties are ready for exemption and will be released during 1907 (See Fig. 2,

Fig. 2.—Tick Fever Cattle Quarantine Line across North Carolina, 1907.

The twenty counties which have been released from Federal quarantine restrictions, because of the work done in eradicating ticks, sell over $525,000 worth of cattle annually. If the loss caused by the ticks and the quarantine restrictions amounted to only one-eighth of a cent a pound, and it probably amounted to much more, it meant a loss on the cattle sold by these counties of not less than $25,000 annually, which is much more than the entire amount expended in eradicating the ticks.

Briefly stated, the method of extermination found most applicable to our condition is as follows: Inspectors are employed who make a farm to farm canvass of the territory with a view to locating all tick-infested farms, which are at once quarantined and the owners carefully instructed as to the importance and object of the work, and especially as to the easiest and best means of exterminating the ticks on their farms.

For killing the ticks the methods found most applicable to the conditions existing in this State and which will apply in the other Southeastern States are as follows:

1. Keep all cattle, horses and mules out of the tick-infested pastures, lanes and lots after September 1st, or better, after August 15th, and all eggs previously laid will hatch before cold weather and the young ticks starve to death by May 1st.

2. Divide the pasture by a fence with a rail or board tight on the ground, or by two fences 15 to 20 feet apart, and the first year keep all cattle, horses and mules out of one-half after August 15th. The

second year, after May 1st, put the cattle on the half left vacant the year previous, and also provide new lanes and lots on ground over which no cattle ran the year before.

One wire fence may be used for dividing the pasture if before the cattle are turned into the free part in the Spring this fence be moved back fifteen or twenty feet on to the part left unoccupied the fall before.

3. If practicable, burn the pasture over thoroughly early in the spring. Begin not later than April 15th or August 15th greasing the legs and underparts of the bodies of all cattle and repeat it once a week until the ticks entirely disappear, three or four months. While greasing the cattle look carefully for any ticks that may have escaped the grease or attached themselves to the upper parts of the body, and if any are found, pick them off and burn. The grease may be Beaumont crude oil or one part kerosene and three or four parts any cheap sort convenient, such as cotton-seed oil. If a little sulphur and tar be added the effect will be prolonged and increased. The grease prevents young ticks attaching themselves to the cattle and kills those already on by plugging the small openings in the body through which they breathe.

If the greasing and hand-picking be done thoroughly and no ticks allowed to drop in the pastures, lanes or lots for four months during the warm season or for eight months in winter, the effort will be successful.

Either of the first two methods, when it can be adopted, is always certain to exterminate the ticks; but the third is not applicable to large herds, and will fail unless it be carefully and thoroughly carried out.

If the herd be large and a change or division of the pasture is impracticable, but it is still desired to exterminate the ticks, or at least reduce their numbers and thereby lessen their depleting effects on the cattle, much good may be done by an occasional spraying with kerosene emulsion or dipping in Beaumont crude oil. Both these methods of attacking the ticks necessitate considerable expense for apparatus, which is only justified when the herd is large. Moreover, no satisfactory substance has yet been found for use as a dip or spray when the complete destruction of the ticks in a pasture is aimed at, because the frequent applications necessary are injurious to the cattle.

Very respectfully,

TAIT BUTLER,
Veterinarian.

REPORT OF THE POULTRY DIVISION.

PROF. B. W. KILGORE, *Director.*

DEAR SIR:—I beg to submit the following report of the work in the Poultry Division for the year ending June 30, 1906:

I am glad to be able to report that the improvement in the health of our flock, which I reported last year, has continued and that we have not had any outbreak of disease among our fowls the past year.

One building has been erected during the year for the accommodation of the male birds when not in use in the breeding pens.

I believe that it is an advantage in any case to have the males away from the females at all times except when the eggs are wanted for hatching, but it is specially necessary in warm climates during the summer months if the eggs are to get to market in good condition.

During the summer it is quite common for eggs in transit to become warm enough to start the germ to grow and when the egg becomes cooled the germ dies and putrification at once starts and it is therefore no uncommon thing for eggs that left the shipper in good condition to reach the market in a damaged state and bring several cents per dozen less than sound eggs are selling for. We have losses in the poultry business that are hard to avoid, but this is not one of them as the remedy is simply to keep the male birds away from the hens through the warm weather.

In order to test the relative keeping qualities of fertile and infertile eggs the male was left in one pen when we broke up our breeding pens at the end of the hatching season and the eggs from this pen were gathered and put up with an equal number from the pens from which the males had been removed, and although the conditions were favorable to the fertile eggs, as all were kept in a fairly cool cellar, it was found that while all the infertile eggs were good fifteen per cent of those fertilized, or from the pen where the male was with the hens, although all the eggs may not have been fertile, were entirely unfit for use and most of the others were of inferior quality.

Pedigree breeding for egg production was started this year, trap nests being used so that an accurate record of the eggs laid by each hen could be kept. Those that were found to be the best layers were kept over for breeders the next year and the chicks from them will be marked so that they can be identified when we come to mate our birds for the next season's work.

Our two best layers were barred Plymouth Rocks and taking them as a pen they were also at the head of the list, that is, they not only had the best individual record, but the best average for the pen. White Plymouth Rocks were second and not far behind the barred.

This work has brought out a point that I have tried to impress on persons who have asked which breed is the best for egg production, viz: That there is often more difference between birds of the same breed than there is between different breeds and that it is a matter of individual selection. The barred Plymouth Rocks had the best record and several of them laid over sixty per cent during the winter months, but then we had one of the breed that never laid an egg all the year and another that laid only about a dozen.

Owing to the improved health of the flock we had a much larger number of chickens to dispose of in the fall, all of which were disposed of to the farmers and poultrymen of this and the adjoining States at fair prices.

The present spring and summer have been unusually bad for poultry raising on account of the very wet weather and we have had as a consequence a great many inquiries as to the prevention and cure of diseases caused by this condition. In a number of cases we were able to recommend treatment that to a large extent enabled the raisers to avoid the troubles that had been causing serious loss in their flocks.

I attended and spoke at a larger number of Farmers' Institutes this year than previously and the schedule for the coming year, including as it does the meetings for women, calls for a much larger number of talks than were given this year.

No additions to the varieties of poultry kept has been made this year, but the rapid growth in popularity of the Rhode Island Reds, as shown by the larger number exhibited at our Fairs and Poultry Shows and by the increasing number of inquiries that we receive for them, makes me think that we should add this breed to those already kept.

The work planned for the coming year is a continuation of the pedigree breeding for egg production, dry feeding from hoppers in comparison with mash feeding for laying hens, hopper feeding for brooder raised chicks, tests of the value of green food in winter, both as to the number of eggs laid and the percentage of fertility and the number of chicks hatched and a comparison of different methods of cooling and turning eggs in incubators.

Respectfully submitted,

J. S. Jeffrey,
Poultryman.

REPORT OF THE ENTOMOLOGICAL DIVISION.

Director W. B. Kilgore.

Sir:—I herewith submit statement of the work carried on in the Entomological Division of the Station during the past year:

From August, 1905, to June, 1906, I was not in the State, the work being carried on by Mr. R. S. Woglum, Acting Entomologist, to whom credit is due for all work accomplished in that time.

As in previous years much time is taken up in the routine office and laboratory work and the work of nursery inspection. The correspondence has continued to be large, a great number of letters being constantly received asking information concerning various pests to all sorts of crops and products.

The reference collections continue to grow in volume and in value. It is our intention to continue this work at spare times until our collections shall represent, as completely as may be possible, the entire insect fauna of the State.

Instruction at the Agricultural College was carried out as heretofore, courses being offered in three separate classes in the College.

Experiments to test the comparative value of several different mixtures for control of San Jose Scale were carried on at Southern Pines, and it is hoped that the results may be published soon.

Comparative tests of jarring and spraying methods of combatting the Curculio on peach trees have been made this spring, and it is hoped that the results will warrant some change in the costly methods now in common use. Another season's work may be needed before the results of these tests should be published.

The resignation of Mr. Bentley a year ago, and my own leaving a month or two later, altered the plans made for an extended inquiry into the bee-keeping industry as it now exists in the State. However, two colonies of bees have been started on the balcony of the Department of Agriculture building, and we will likely later make some changes in the management of the swarms at the Station farm. But apiculture is in reality a science in itself and if it were desired to conduct a thorough inquiry into the industry in this State and to make actual investigations of use to bee-keepers, an expert bee-keeper should be employed for that work. The time does not now seem to be ripe for such a step.

Respectfully submitted,

Franklin Sherman, Jr.

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION IN ACCOUNT WITH THE UNITED STATES APPROPRIATIONS, 1905-1906.

DR.

To receipts from the Treasurer of the United States, as per appropriations for the fiscal year ending June 30, 1906, as per Acts of Congress, approved March 2, 1887, and March 16, 1906.

Hatch Fund	$15,000.00
Adams Fund	5,000.00

CR.

	Hatch Fund.	Adams Fund.
By Salaries	$9,766.69	$965.32
Labor	1,778.35	
Publication	553.92	
Postage and stationery	434.90	
Freight and express	71.06	9.84
Heat, light and water	91.10	
Chemical supplies	82.25	518.14
Seeds, plants and sundry supplies	301.61	34.03
Fertilizers	211.73	303.57
Feeding stuffs	619.77	
Library	39.41	313.15
Tools, implements and machinery	206.94	1,484.02
Furniture and fixtures	128.82	
Scientific apparatus	17.27	964.41
Live stock	53.00	175.00
Travelling expenses	223.30	
Contingent expenses	15.00	
Building and repairs	404.88	232.52
Total	15,000.00	5,000.00

We, the undersigned, duly appointed auditors of the corporation, do hereby certify that we have examined the books and accounts of the North Carolina Experiment Station for the fiscal year ending June 30, 1906; that we have found the same well kept and classified as above, and that the receipts for the year from the Treasurer of the United States are shown to have been $20,000, and the corresponding disbursements $20,000; for all of which proper vouchers are on file and have been by us examined and found correct, thus leaving nothing.

And we further certify that the expenditures have been solely for the purposes set forth in the act of Congress, approved March 2, 1887, and March 16, 1906.

(Signed) S. L. PATTERSON,
B. W. KILGORE,
Auditors.

(Seal.)

Attest: A. F. BOWEN, *Custodian.*

Bulletin No. 193. **February, 1906.**

NORTH CAROLINA

Agricultural Experiment Station

OF THE

College of Agriculture and Mechanic Arts

RALEIGH

Spraying Mixtures and Machinery.
When and How to Spray.

N. C. COLLEGE OF AGRICULTURE AND MECHANIC ARTS.

THE NORTH CAROLINA

AGRICULTURAL EXPERIMENT STATION

UNDER THE CONTROL OF THE

TRUSTEES OF THE A. AND M. COLLEGE.

S. L. PATTERSON, *ex officio* Chairman, Raleigh.

J. M. FOREHAND ..... Tyner.	A. T. MCCALLUM ..... Red Springs.
J. B. STOKES ..... Windsor.	J. P. MCRAE ..... Laurinburg.
WM. DUNN ..... Newbern.	R. L. DOUGHTON ..... Laurel Springs.
C. N. ALLEN ..... Auburn.	W. A. GRAHAM ..... Machpelah.
R. W. SCOTT ..... Melville.	A. CANNON ..... Horse Shoe

STATION STAFF.

GEORGE T. WINSTON, L.L D., President of the College.

B. W. KILGORE ..... Director.
W. A. WITHERS ..... Chemist.
C. W. BURKETT ..... Agriculturist.
TAIT BUTLER ..... Veterinarian.
F. L. STEVENS ..... Biologist.
H. H. HUME ..... Horticulturist.
J. S. JEFFREY ..... Poultryman.
R. S. WOGLUM ..... Acting Entomologist.
B. F. WALTON ..... Assistant in Field Experiments.
J. C. KENDALL ..... Assistant Dairy Husbandry.
O. L. BAGLEY ..... Assistant Chemist.
R. H. HARPER ..... Assistant Chemist
A. F. BOWEN ..... Bursar.

The Director's office is in the Agricultural Building, Raleigh : the experiment grounds and laboratories being at the Agricultural College, just west of town and on the street car line.

Visitors will be welcome at all times, and will be given every opportunity to inspect the work of the Station. Bulletins and Reports are mailed free to all residents of the State upon application.

Address all communications to

THE AGRICULTURAL EXPERIMENT STATION,
RALEIGH, N. C.

TABLE OF CONTENTS.

Mixtures and Machinery.

When and How to Spray.

BY

F. L. STEVENS, Biologist,

AND

R. S. WOGLUM, Acting Entomologist.

INTRODUCTION.

The constant demand by people from all parts of the State for information as to what spray to use in combating the different insect and fungous troubles, and how to make their spraying mixtures, has led to the preparation of this bulletin. The information is given in a brief but accurate manner. For more detailed accounts special bulletins issued by this Station should be consulted. They will be sent gratis upon application.

An attempt has been made to set forth the more important insect pests and fungous troubles in such a way that it can be seen at a glance what spray to use and when to apply it. In this direction one point should be constantly held in mind: **Whenever an insecticide and a fungicide are to be used at the same time, it is usually possible, provided the insecticide is an arsenate compound, to combine the two, so that only one application is necessary.**

WHEN AND WHAT TO SPRAY.

APPLE.

Scab, Leaf Spot, Sooty Fungus: Use copper sulfate 1-25 before buds open. Bordeaux just before blossoms open, again seven days after blossoms drop; repeat every ten to fourteen days. **Rust:** Cut out cedar trees if possible. **Bitter Rot** and **Ripe Rot:** Spray as above, cut out canker and avoid bruising.

Aphis: Apply 15 per cent kerosene emulsion when lice appear; treat root form by removing dirt at base of tree until roots are exposed; sprinkle on tobacco stems and replace dirt. **Canker Worm:** Use Paris green or arsenate of lead as soon as first caterpillars appear; repeat after five days. Band trees before moths appear in spring. **Codling Moth:** Paris green or arsenate of lead as soon as blossoms fall; repeat in ten days. **Curculio:** See Plum. **Fall Web-Worm:** Arsenate of lead on leaves around nest, or destroy nest by burning. **Oyster-Shell Scale:** Use 15 per cent kerosene emulsion as soon as young hatch in spring; repeat when necessary. **San Jose Scale:** Lime-sulphur-salt in spring just before buds swell. **Scurfy Scale:** Same as for Oyster-Shell Scale. **Tent Caterpillar:** Same treatment as for Fall Web-Worm. **Tussock Moth:** When caterpillars appear spray with arsenate of lead or Paris green. Destroy egg masses in winter. Band trees to prevent ascent of female moths.

ASPARAGUS.

Rust: If you are troubled with this disease write to the Station for special directions.

Beetle: Dust frequently with pyrethum for worms. Destroy all uncultivated stocks. After cutting has stopped, spray with arsenate of lead or Paris green.

BEAN.

Anthracnose, Leaf Blight: Bordeaux every ten or fourteen days after plants are four inches high and until pods are half grown.

Leaf Beetle: Use Paris green, 1 pound to 150 gallons water.

NOTE—When lime, sulfur and salt is used before buds open, the first application of copper sulphate is not needed. Any arsenate for insects may be applied in Bordeaux mixture.

Striped Cucumber Beetle: See Cucumber. **Weevils:** Fumigate seed with carbon bisulphide.

BLACKBERRY, RASPBERRY, DEWBERRY.

Leaf Blight, Anthracnose: Copper sulfate 1-25 just before leaf buds open; just before blossoming and after harvesting use Bordeaux. Use weak Bordeaux on young canes when six inches high.

Rust: Dig and burn plants.

Anthracnose: Cut out infested canes.

CABBAGE.

Club Foot: Rotate crops.

Harlequin Cabbage Bug: Plant early trap strip. When beetles are numerous spray with pure kerosene. **Plant Lice:** When plants are young use 10 per cent kerosene emulsion; after headed, tobacco water. **Root Maggot:** Pour around base of plants an emulsion of 1 pound soap, 1 gallon boiling water, and 1 pint crude carbolic acid, or inject carbon bisulphide in ground near base of plant. **Worms:** Paris green when plants are young; when headed dust on hellebore or pyrethum.

CELERY.

Leaf Spot: Bordeaux on young seedlings and repeat every ten or fourteen days.

CHERRY.

Brown Rot, Shot Hole: Use copper sulfate 1-25 before buds open. When fruit is set use Bordeaux mixture. Repeat every ten or fourteen days until two-thirds grown.

Black Knot: Cut out and burn.

Aphis: Kerosene emulsion 15 per cent when insects appear; repeat when necessary. **Curculio:** See Plum. **San Jose Scale:** See Apple. **Slug:** Arsenate of lead or Paris green at first appearance.

CHRYSANTHEMUM.

Leaf Spot: Bordeaux every ten or fourteen days.

CORN.

Red Spider: See Cotton. **Weevil:** Use carbon bisulphide.

COTTON.

Lice: Use 10 per cent kerosene emulsion. **Red Spider:** Lye-sulphur wash as soon as first appear. Spray both plants infested and

those immediately adjoining. **Caterpillar:** Paris green 1 pound to 60 gallons water; or as a dust mixed with dry air-slaked lime, or flour.

COWPEAS.

Bean Leaf Beetle: See Bean.

CUCUMBER.

Anthracnose, Downy Mildew, Fruit Spot: Bordeaux when vines are one-half yard long; repeat every ten or fourteen days as need be.

Aphis: Use 10 per cent kerosene emulsion. **Striped Cucumber Beetle:** Use Bordeaux mixture and Paris green frequently. **Spotted Cucumber Beetle:** Same as for Striped Beetle.

CURRANT AND GOOSEBERRY.

Worm: Bordeaux mixture and Paris green when worms appear; when fruit is formed use hellebore.

GRAPE.

Black Rot, and other Fungous Diseases: Copper sulfate 1-7 before leaf buds open. Bordeaux 6-4-50 before blossoming, again ten or fourteen days after blossoming and every ten days thereafter until the middle of July.

Destroy old leaves and rotten grapes, or cover what cannot be destroyed by cultivating.

(Write for bulletin 185 of this Station.)

Aphis: Use 15 per cent kerosene emulsion. **Berry Moth:** Use arsenate of lead, 4 pounds to 50 gallons water, just before blossoms open; repeat after petals fall. **Flea Beetle:** When buds begin to swell use Paris green, 1 pound to 75 gallons water, or arsenate of lead; when worms appear on leaves repeat. **Leaf Hopper:** Whale oil soap 1 pound to 10 gallons water; apply to under surface of leaves. **Root Worm:** As soon as beetles appear use arsenate of lead, 4 pounds to 50 gallons water. Repeat ten days later. **Rose Beetle:** See Rose.

LETTUCE.

Aphis: Spray with tobacco water. **Harlequin Cabbage Bug:** See Cabbage.

MUSKMELON.

See Cucumber.

ONION.

Maggot: Treat in same way as Cabbage Maggot.

NURSERY STOCK.

Fungous Diseases: Bordeaux when leaves are out. Repeat every ten or fourteen days.

Plant Lice: Use 15 per cent kerosene emulsion. **San Jose Scale:** Fumigate with hydrocyanic acid gas, or destroy.

OATS.

Smut: Use formalin. (Write for Special Bulletin.)

PEACH.

Curl, Brown Rot, Mildew, Scab: Copper sulphate 1-25 in early spring before leaf buds open; as blossoms fall use weak Bordeaux. Repeat every ten or fourteen days until fruit is two-thirds grown.

Rosette
Yellows } Dig out and burn as soon as recognized.
Little Peach

Brown Rot: Destroy dead peaches on ground under tree in earliest spring or autumn.

Black Peach Aphis: Treat as for Apple Aphis. **Curculio:** See Plum. **San Jose Scale:** See Apple.

PEAR.

Leaf Blight, Scab: Use Bordeaux when leaves are half grown; again just before blossoming; again after fall of blossoms.

Blight: Cut and burn.

Fall Web-Worm: See Apple. **Leaf Blister Mite:** In spring just before buds break use 20 per cent kerosene emulsion. **San Jose Scale:** See Apple. **Scurfy Scale:** See Apple. **Slug:** Paris green or arsenate of lead when insects appear; repeat if necessary.

PLUM.

See Cherry. **Black Knot:** Cut and burn. **Pockets:** Cut out.

Curculio: Arsenate of lead just before blossoms open; repeat after petals fall. Follow second spray by jarring trees. **San Jose Scale:** See Apple.

POTATO—(IRISH).

Blights: Use Bordeaux mixture when six inches high; repeat every ten or fourteen days till end of growth, using Paris green and Bordeaux when **insects** appear.

ROSE.

Mildew: Potassium sulfide before leaves open and repeat if need be.

Aphis: Use 15 per cent kerosene emulsion. **Rose Bug, or Chafer:** As soon as beetles appear use arsenate of lead, 4 pounds to 50 gallons water; repeat in five to seven days. **Rose Scale:** Spray with 20 per cent kerosene emulsion in spring just before buds break. When young appear use 15 per cent kerosene emulsion. **Slug.** Spray with Paris green or tobacco water; or dust on hellebore.

STRAWBERRY.

Fungus Diseases: Use Bordeaux early, and again just before first blossoms open.

TOMATO.

Rot: Bordeaux before appearance of rot and repeat every ten or fourteen days.

TOBACCO.

Flea Beetle: Same as for potato Flea Beetle. **Horn Worm:** Paris green 1 pound to 160 gallons water. **Cigarette Beetle:** Carbon bisulphide.

WATERMELON.

(See Cucumber.)

NOTE.—When lime, sulphur and salt is used before buds open, the first application of copper sulphate is not needed. Any arsenate for insects may be applied in Bordeaux mixture.

FUNGICIDES.

The efficiency of fungicides depends upon the fact that many plant diseases are caused by fungi. These fungi gain entrance to the plant at the surface by means of reproductive bodies called spores. The fungicide is a mixture which is spread upon the surface of the plant which by its poisonous properties prevents the spores from successfully germinating and gaining entrance into the plant.

Spraying for fungous diseases is recognized, by the successful horticulturist, as a necessary measure.

BORDEAUX MIXTURE.

This mixture, which takes its name from its place of discovery, Bordeaux, in France, is the most widely used and with certain limitations the most effective fungicide. It consists of copper sulfate (blue vitrol or blue stone) and quick lime mixed with water in various proportions.

The chief strengths of Bordeaux are as follows:

4—4—50.

Copper sulfate or blue stone	4 pounds.
Quick lime	4 pounds.
Water	50 gallons.

This strength may be used on most plants the foliage of which is not susceptible to injury.

6—4—50.

Copper sulfate or blue stone	6 pounds.
Quick lime	4 pounds.
Water	50 gallons.

This second is particularly for grapes.

Those plants with delicate foliage, such as the peach, plum, cherry and apricot, demand weaker solutions, consisting of

2—2—50.

Copper sulfate	2 pounds.
Lime	2 pounds.
Water	50 gallons.

Or—

$2\frac{1}{2}$—6—50.

Copper sulfate	$2\frac{1}{2}$ pounds.
Lime	6 pounds.
Water	50 gallons.

There is no certainty as to which of these strengths is best. To most crops no damage can come from the use of as strong a solution as

6—4—50, yet it is possible that all of the good can be accomplished by the 4—4—50. If so, there would be a loss of material through the use of the stronger solution. This matter is open to experimentation.

In the preparation of the Bordeaux mixture, it is well to have on hand stock solutions of copper sulfate and lime. The stock solution of copper sulfate should be made by dissolving a certain number of pounds of copper sulfate in one-half the number of gallons of water. —For example: 80 pounds copper sulfate in 40 gallons of water. Every gallon of this stock solution will contain 2 lbs. of copper sulfate, and the necessity of further weighing is avoided. The stock solution will remain good for any length of time if water evaporated is replaced. In order to dissolve the copper sulfate, it is best to tie it in a coarse bag and suspend it near the top of the liquid. In this way it will dissolve in a few hours. If it is placed in the bottom of a barrel it will dissolve but slowly, even with constant stirring. It is well to dissolve the copper sulfate the night before you are ready to make the mixture, and it will then be ready in the morning.

In a similar way a stock solution of lime should be made. Quick lime of good quality, which is not at all slacked, should be weighed out and placed in a trough and slaked slowly, using a very small quantity of water. By slaking slowly a finer quality of lime is secured. After the lime is thoroughly slaked it should be mixed with enough water to make a putty-like mass. This may be covered with more water to keep out the air and may be used when needed. Since this mass was originally weighed, you can estimate nearly enough for any given amount of Bordeaux mixture.

In preparing the Bordeaux mixture from stock, measure out the proper amount of stock solution of copper sulfate, and dilute it with half the amount of water needed. In a similar way measure out the proper amount of lime needed from the stock and dilute it with the other half of water in a separate vessel.

The lime should be passed through a fine wire strainer of about thirty meshes to the inch, or through cheese cloth, in order to remove the particles of stone, or it will otherwise cause great difficulty in the pump nozzle when spraying.

We now have the two ingredients each mixed with one-half the amount of water called for in the formula. All that remains is to mix these two solutions. They should be poured together slowly and thoroughly stirred.

It is a matter of considerable importance that the stock solutions be diluted before they are mixed with each other. The quality of Bordeaux mixture resulting from this method is superior in several respects to that which would be made if strong solutions were mixed together and afterwards diluted.

The Bordeaux should be freshly made each time before using.

SODA OR POTASH BORDEAUX MIXTURE.

While the Bordeaux mixture is eminently successful in preventing many plant diseases, slight difficulty is sometimes encountered owing to the occurrence of small stones, resulting from imperfections in lime. These, if not thoroughly strained out, clog the spraying nozzle and are troublesome. To escape this difficulty and to render the preparation and application of the Bordeaux mixture easier, as well as to give a mixture suitable for use as the fruit approaches maturity, the use of potash of soda as substitutes for the lime has been recommended.

THE SODA BORDEAUX.

Copper sulfate (blue stone) ..... 5 pounds.
Commercial caustic soda sufficient to combine with copper sulfate and leave a slight excess of soda.
Water ..... 50 gallons.

It will be noted that the amount of caustic soda to be used is not stated definitely. It is impossible to make a definite statement, as the strength of the various commercial sodas varies greatly.

The following table, however, gives the amount of copper sulfate required for a single can of several of the more common sodas. In the last column is found the amount of mixture which a can will make. For example, if you choose to use the Champion soda, a can of which weighs 13.73 ounces, you should use 1.6 pounds of copper sulfate to each can of soda. One can of soda contains 12 ounces of substance and the 1.6 pounds of copper sulfate together with the one can of Champion soda will make thirteen gallons of soda Bordeaux.

In a similar way, by consulting the table you may find how much copper sulfate to use per can with any of these brands and how much mixture it will make.

	Gross Weight of Can.	Weight of Substance.	Copper Sulfate Required.	Amount of Mixture.
Soda (Troy)	11.2 lbs.	10.17 lbs.	46.22 lbs.	462 gal.
Babbitt's Potash	17 oz.	14. 5 oz.	3 "	30 "
Champion	13.75 "	12 "	1.6 "	13 "
Red Seal	17 "	14.5 "	2.4 "	24 "
Leggett's	17 "	14.75 "	2.5 "	25 "
Lehman's	14.75 "	12.25 "	2.4 "	24 "
Hirsh	14.5 "	12.75 "	1.8 "	18 "
Washington	14.25 "	12.75 "	1.7 "	17 "
Saponifier (Solid)	15.75 "	14.25 "	2.5 "	25 "
Saponifier (Granulated)	17 "	14.75 "	2.6 "	26 "
Natrona	42.75 "	36.75 "	7.2 "	72 "

Dissolve the caustic soda in water. Dissolve the copper sulfate also in water in another vessel and dilute each to half the volume of the completed mixture, then mix the two solutions together.

If you put together in the above proportions the mixture will be alkaline. If too little soda is used the mixture will be acid, and is then liable to injure the leaves.

In order that the mixture may be more easily seen on the trees, and thus enable the operator to know when the tree has been completely sprayed, add a small quantity of lime, about one-half pound to every fifty gallons of mixture. This will be sufficient to make a visible deposit on the trunk and foliage of the tree, and enable one to distinguish easily the sprayed from the unsprayed portions of the tree.

The strength as given above is really the same as the 5—5—50 Bordeaux mixture. If you prefer to use one comparable to the 4—4—50, increase the amount of water by 25 per cent.

AMMONIACAL SOLUTION OF COPPER CARBONATE.

This solution contains no sediment, and on drying leaves no marks upon the fruit. It may therefore be used upon fruits in the latter stages of their ripening, when the spotting that the Bordeaux mixture causes would preclude the use of that fungicide. The mixture consists of a solution made by dissolving copper carbonate in ammonia water in the following proportions:

Copper carbonate	6 ounces.
Ammonia (about)	3 pints.
Water	50 gallons.

Weigh out the proper amount of copper carbonate, set a very small portion of this aside, and dissolve the remainder of it in diluted ammonia, using only enough to dissolve it, and then add the portion of copper carbonate which was reserved. This will insure that you use no more ammonia than is necessary. It is better to have a little too much of the carbonate in the solution than to have too much ammonia. A strong solution made in this way can be diluted with the proper amount of water. The copper carbonate may be purchased directly from the drug store, or it may be prepared on the farm.

To make copper carbonate proceed as follows: Dissolve ten pounds of copper sulfate (blue stone or blue vitrol) in ten gallons of water. Also dissolve twelve pounds of carbonate soda in the same amount of water. Allow these two solutions to cool, and then mix them slowly together, stirring in the meantime. Allow the mixture to settle about twelve hours, then pour off the liquid and add water equal in amount to the liquid poured off. Stir thoroughly and allow it to settle as before. Repeat this operation again, then drain off all of

the liquid possible, and dry the blue powder which remains. This powder is the copper carbonate.

COPPER SULFATE SOLUTION.

1—17.

A solution consisting merely of copper sulfate and water may be used before the leaves appear, to kill the spores on the trunks and branches of the trees.

Copper sulfate	1 pound.
Water	17 gallons.

Dissolve the copper sulfate as you do in preparing the Bordeaux mixture, dilute it to the required strength, and spray upon the trees. The addition of a little lime, say half a pound to fifty gallons of mixture, enables the operator to see exactly what portions of the tree have been sprayed.

This mixture must not be used after the leaves appear.

COPPER SULFATE.

1—7.

Made as above, but using 7 instead of 17 pounds of copper sulfate.

POTASSIUM SULFIDE SOLUTION.

Potassium sulfide (or liver of sulphur)	1 ounce.
Water	2-4 gallons.

This solution should be freshly prepared. It is used as a substitute for the Bordeaux mixture in the same way as the ammoniacal solution of copper carbonate is used, when the fruit has become so large that the Bordeaux mixture must be discontinued to avoid spotting. Potassium sulfide is especially efficient as a protection against the powdery mildews.

FORMALIN.

Formalin is a very powerful germicide which recently came into wide use. Its interest to the farmer lies chiefly in its value in preventing the potato scab, the onion smut, and the various smuts of cereals. Full directions for using this are found in other bulletins of this Station.

Two forms of this substance appear on the market. One under the name of formalin, and the other under the name of 40 per cent formaldehyde. These substances are absolutely identical, and as the 40 per cent formaldehyde is cheaper, owing to the fact that the word formalin is protected by a patent, the farmer, of course, will do well to use the 40 per cent formaldehyde.

INSECTICIDES.

The choice of the spray mixture to be used in fighting insect pests depends largely upon a principle little understool by the average farmer, and yet to the entomologist it is the first thing to be considered. It is "in what form does the insect to be fought take its food, as solid matter, or by sucking the juices from the plant?"

On this principle insects fall into two classes which are separated by the character of their mouth parts: (1) *Biting Insects* include those whose mouth parts are in the form of jaws by means of which they bite from the leaves of plants pieces which are taken into the stomach. Examples: grasshoppers, cabbage worms, and tobacco worms. (2) *Sucking Insects* include those whose mouth parts are in the form of a beak, or needle-like apparatus, which they insert in the plant and derive therefrom the juices. Examples: plant lice, scale insects, and harlequin cabbage bug. In the former case the poison is applied to the foliage so as to be taken into the stomach along with the food. These poisons are called stomach poisons, and the articles most commonly used are compounds of arsenic: as Paris green, London purple, or arsenate of lead.

With the sucking type of insect a different method of treatment must be followed. Poison on the surface of the plant has no effect on these "sap-suckers," as they derive their food from within the plant. Since we are not able to put the poison inside the plant tissue to be sucked in by the insect with the juices, the only thing to do is to use some substance which will kill the insects by acting externally on their bodies. Arsenic poisons will *not* accomplish this purpose. The best contact poisons are such as soaps or oils.

FOR BITING INSECTS.

PARIS GREEN.

Paris green	1 pound.
Water	60-250 gallons.
Fresh stone lime	1 pound.

Slake the lime in the usual way by adding water (either warm or cold). Warm water will cause the lime to slake much more readily than cold. Strain the slaked lime through cheese cloth into a pail, and pour in enough water to nearly fill the pail. Add the green (which should first be made into a paste by the addition of a little warm water) and stir thoroughly. Then pour this mixture into the required amount of water and the resultant is ready for use. The lime is added to prevent the green burning the foliage of the plants sprayed. In the case of some plants, however, the pure green at the

concentration used will not injure the foliage, thus making the addition of lime unnecessary. Unless the farmer is thoroughly acquainted with the different resistant plants it is better to add the lime. In case of doubt add lime.

London Purple.

London purple	1 pound.
Water	60-200 gallons.
Fresh stone lime	2-3 pounds.

This mixture is made in the same way as Paris green. Its more caustic properties makes necessary the addition of two or three times its weight of lime. Never fail to add the lime whatever sort of plant is sprayed. London purple is somewhat cheaper than Paris green, yet because of the fact that its chemical composition varies from time to time, and hence it cannot be relied upon to always give good results, use the latter poison where obtainable.

Arsenate of Lead.

Acetate of lead	12 ounces.
Arsenate of soda	4 ounces.
Water	50 gallons.

Put the acetate of lead into a gallon of water in a wooden pail; in another wooden pail put the arsenate of soda in two quarts of water. When both are dissolved, pour them together into the spray tank containing the required amount of water. A white precipitate of lead arsenate immediately forms in the tank and the mixture is ready to be applied.

Arsenate of lead has some advantages over all other arsenic mixtures. *It is absolutely harmless to foliage even when applied in large quantities*, and its finely divided condition causes it to remain in suspension many times longer than Paris green, London purple, or most of the other arsenic compounds.

On the market there are now found several kinds of arsenate of lead ready for use; sometimes in the form of a dry powder, sometimes in the form of a paste. "Swift's Arsenate of Lead," and "Disparine," a preparation made by the Bowker Insecticide Company, of Boston, are two forms of the paste. Both are excellent preparations and are very effective. However, their greater cost than the home-made material usually makes it advisable to use the latter.

Arsenite of Lime.

White arsenic	1 pound.
Fresh stone lime	2 pounds.
Water	2 gallons.

Slake the lime; then put the slaked lime and arsenic into a gallon of water and boil 40 minutes. Remove, and add water enough to make two gallons stock solution. *Use one quart of this stock solution to fifty gallons of water.* Arsenite of lime at this strength compares favorably with Paris green where used at the rate of one pound green to one hundred and fifty gallons of water. Its main recommendation is its low cost, being the cheapest of the arsenic compounds. When improperly made arsenite of lime is liable to burn the foliage, hence carefulness in preparation is a necessity. Do not boil ten or fifteen minutes, *but boil the entire forty minutes,* to make certain that the arsenic has been dissolved.

Arsenite of Lime with Soda.

White arsenic	1 pound.
Sal soda	4 pounds.
Water	2 gallons.
Fresh stone lime	2 pounds.

Dissolve the sal soda in a gallon of water, add one pound of white arsenic and boil fifteen minutes, or until the arsenic has dissolved. Then add two pounds of fresh slaked lime and boil fifteen minutes more. Remove and add water to make two gallons stock solution. *Use one quart stock solution to fifty gallons of water.*

This mixture has practically the same properties as arsenite of lead without the soda, and can be used wherever the latter is. The addition of soda, however, renders the mixture less liable to injure foliage. As in the case of the preceding mixtures, it can be safely used if carefulness in preparation is observed.

Hellebore.

Fresh white hellebore	1 pound.
Water	2 gallons.

Steep the hellebore in a quart of boiling water and add the rest of the water when ready to spray. Hellebore may also be dusted on the plants as a dry powder, and at its full strength. Where the powdered form is used it should be applied when the plants are moist with dew.

FOR SUCKING INSECTS.

*Lime-Sulfur-Salt Wash.

Stone lime	20 pounds.
Sulfur (flowers)	17 pounds.
Salt	10 pounds.
Water (to make)	50 gallons.

*Write for Entomological Circular No. 13.

Mix the sulfur with five or six gallons of hot water in a large iron kettle over a fire. Add the lime, and as it slakes dash in cold water as needed to prevent boiling over, and to keep to a thin liquid consistency. As slaking ceases add the salt, and boil forty minutes longer. Keep stirring frequently. Then strain, and add water to make fifty gallons. Spray while warm or hot.

This wash is sometimes made without the salt, and some authorities hold that their success in its use has been as marked without the addition of salt as with salt. Salt adds to the sticking quality of the wash, and it is not definitely known but that the combination of lime and sulfur is favorably influenced by it. We recommend the addition of salt. Lime, sulfur and salt is a winter wash, and should consequently be applied to trees only when they are in a dormant condition. It is the best known insecticide for the San Jose scale. Besides its insecticidal value, it also has a certain effect as a fungicide.

Lime, Sulfur and Soda.

Stone lime	30 pounds.
Sulfur	17 pounds.
Caustic soda	6 pounds.
Water	50 gallons.

Pour some hot water onto the lime, and as soon as it begins to slake add the sulfur (which should be made into a thin paste by means of water). Stir thoroughly and continually. When the lime is nearly slaked, add the caustic soda, part at a time. Hot water should be added as needed to keep it to a liquid consistency. When boiling has ceased, the proper amount of water (preferably hot) should be added to make fifty gallons.

This wash is sometimes used in place of the fire or steam boiled lime, sulfur and salt wash. However, it is not quite as effective as the latter, and should not be used where the latter is obtainable.

*Kerosene Emulsion.

Kerosene	2 gallons.
Water	1 gallon.
Soap	½ pound.

Shave the soap into the water and heat to boiling to dissolve. When dissolved, remove from the fire and pour in the kerosene. Churn together very thoroughly by putting the material into the spray pump, and pumping the emulsion back into itself for several minutes. Before using, this emulsion should be diluted to the strength needed. To get 10 per cent oil, add 17 gallons of water. To get 15 per cent, add 10½ gallons of water. To get 25 per cent, add 5 gallons of water.

* Write for Entomological Circular No. 10.

Kerosene and Water.

A mixture of kerosene and water can be used in those cases where kerosene emulsion is employed, and at the dilution recommended for the latter. The mixture is made with the use of a spray pump built especially for that purpose, which has a kerosene attachment. As these pumps cannot always be relied upon to give a uniform amount of kerosene it is advisable to leave them alone.

Whale Oil Soap.

Whale oil soap	1 pound.
Water	2-6 gallons.

Dissolve the soap in hot water.

Lye-Sulfur.

Flowers of sulfur	20 pounds.
Caustic soda	10 pounds.

Make the sulfur into a paste with cold water, and then add the soda. Dash in cold water from time to time to prevent burning. When boiling has ceased, add water enough to make 20 gallons of stock solution. Use two gallons of this mixture to 50 gallons of water. This wash is used principally for the red spider.

Tobacco.

Put tobacco stems in a water-tight vessel, pour in boiling water enough to cover the tobacco, and allow to stand several hours. Dilute two or three times before using. Tobacco may also be used as a finely ground powder.

BOTH FOR BITING AND SUCKING INSECTS.

Pyrethum.

Pyrethum is usually applied as a dry powder at its normal strength, or it may be mixed with twice its bulk of flour and then used. Used as a spray, water is added in the following proportions:

Pyrethum	1 pound.
Water	3 gallons.

Keep the powder in a tightly-corked can. If exposed to the air it soon loses its effect. The high cost of pyrethum restricts its use more especially to plants grown indoors.

Carbon Bisulphide.

Use at the rate of 1 pound of bisulphide to 1,000 cubic feet of space. Where a smaller area is to be covered use about a teaspoonful to each cubic foot of space. Place in shallow dishes on top of the grain to be treated. The fumes are heavier than air and thus will penetrate throughout the box. The box or closet in which the grain

is treated should be tight. After leaving 24 hours, open, and air for half an hour before using. Do not use a fire of any kind, not even a lighted cigar or pipe, near the fumes.

Hydrocyanic Acid.

This gas is used especially in fumigating nursery stock, in treating fruit trees, and in green-houses. With nursery stock the following proportion is used:

Cyanide of potassium	1 ounce.
Sulphuric acid	2 ounces.
Water	4 ounces.

Pour the water into a glass or earthenware dish and add the sulphuric acid. Drop in the cyanide and immediately tightly close the box or room. Allow this to stand forty minutes, then open. This formula suffices for 100 cubic feet of space. Should there be a larger or smaller amount of space to be covered, increase or decrease the formula proportionally. As, for instance, the room contained 500 cubic feet of space, then use five times the above formula; if 50 cubic feet, use one-half the formula. This particular formula applies only to nursery stock. In treating green-houses, a smaller amount of cyanide should be used, yet the principle of preparation is the same in all cases. *Hydrocyanic acid gas is deadly poisonous, thus the greatest care must be exercised in its use.*

INSECTICIDES AND FUNGICIDES COMBINED.

Bordeaux Mixture and Paris Green.

Copper sulfate	4 pounds.
Fresh stone lime	4 pounds.
Water	50 gallons.
Paris green	5 ounces.

Make the Bordeaux mixture as given on another page. Mix the green with water to form a paste, then stir into the Bordeaux. The green may be used in a larger amount than given in the above formula, but this is generally unnecessary.

By combining Bordeaux mixture with some arsenite, as Paris green, many fungous diseases and insect pests can be struck at the same time. This combination method saves a separate application of each substance, which would be necessary were the Bordeaux and arsenic compounds applied at separate times. Its range of usefulness is not exceeded by any of our spraying mixtures. Bordeaux mixture and Paris green can be applied together with perfect safety.

The other arsenious mixtures, as London purple, arsenate of lead, or arsenite of lime, may also be combined safely with Bordeaux mixture.

SPRAYINC APPARATUS.

When the farmer, fruit grower, or gardener decides to spray, the first question that comes up is, what sort of spray pump and outfit he should obtain. To assist him in his selection, some of the types of spraying apparatus most commonly used will be given. It is hoped that, after a careful consideration of the different types of pumps herein given, he may be able to select the kind best suited to his own particular needs.

There are on the market many different kinds of spray pumps, which are manufactured by quite as many different concerns. Each particular kind of pump, whether it be bucket, knapsack, or barrel, has its own particular merits over each other kind. There is no "best" pump, for a pump that is satisfactory to one man might not be what another wants for his particular work. The pump that would be used to spray 10,000 fruit trees would not be the most suitable for using on 100 acres of potatoes, or in a small garden.

One requirement, however, should be made of all pumps purchased. The working parts, or the parts with which the spray liquid comes in contact, should be made of brass or some such metal which will not corrode. Iron will corrode when brought in contact with certain substances commonly present in some spray mixtures. It is important that neither leather nor rubber valves be used; only metal (preferably brass) which are ground to fit their seat perfectly. Valves other than metal will be constantly playing out.

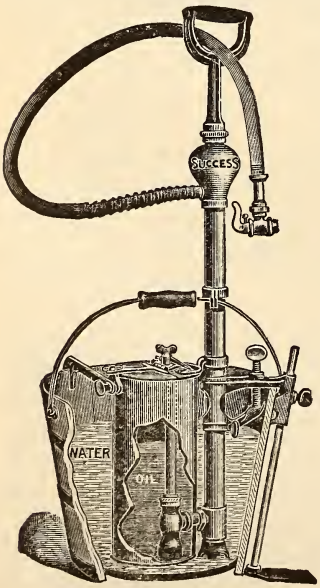


Fig. 1. Bucket Pump with tank for oil.

Bucket Pumps. These pumps are among the most durable of the simple force pumps in common use. The fact that they may be used in any ordinary sort of bucket, or pail, gives them an advantage over some of the other types of outfits. By the attachment of a foot-rest which extends outside the pail to the ground, the pump can be held very firmly. These pumps are suited for such use as in a garden, to spray the bushes in the yard, or a few small fruit trees. They cost from $3 to $7 complete, including rubber hose and a nozzle.

Air-pressure Sprayer. In this sort of apparatus the liquid is thrown out by the action of compressed air. After the tank is partly filled with the spray mixture and closed, air is pumped in which sets up a pressure on the liquid, thus forcing it out in the form of a fine spray.

This sprayer has proven satisfactory with some people, and can be used in about the same field as the bucket pump. The Rochester Spray Pump Company and the E. C. Brown Co., both of Rochester, N. Y., make pumps of this sort, which cost from $4 to $7.

Fig. 2. Compressed-air Sprayer.

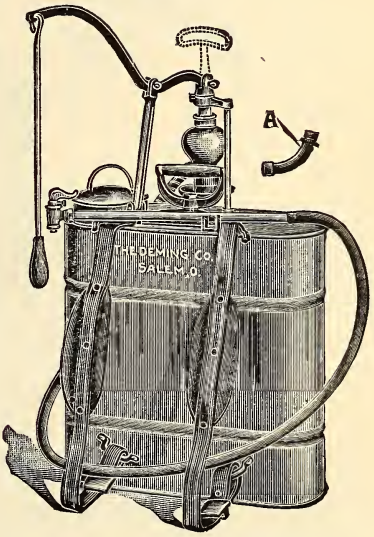


Fig. 3. Knapsack Pump, showing bent neck attachment at "A."

Knapsack Pumps. These pumps consist of a tank holding from three to five gallons, with straps so attached that the outfit can be carried upon the back in the same manner as a knapsack. The handle is so adjusted that it can be operated in front of the carrier. These pumps are put to their best advantage in spraying low-growing crops, such as strawberries, potatoes, or tobacco. They may also be used in spraying small trees. For general garden use, or for the man with a half-acre to an acre of truck crops, this pump is heartily

recommended. In ordering, it is well to get a bent neck attachment as shown at (A), Fig. 3. This is needed in spraying the lower surface of leaves of low-growing plants. Price complete with hose and nozzle $10 to $20.

Barrel Pump. For general orchard work the barrel sprayer is the most important type. In this, the pump is adjusted to a barrel,

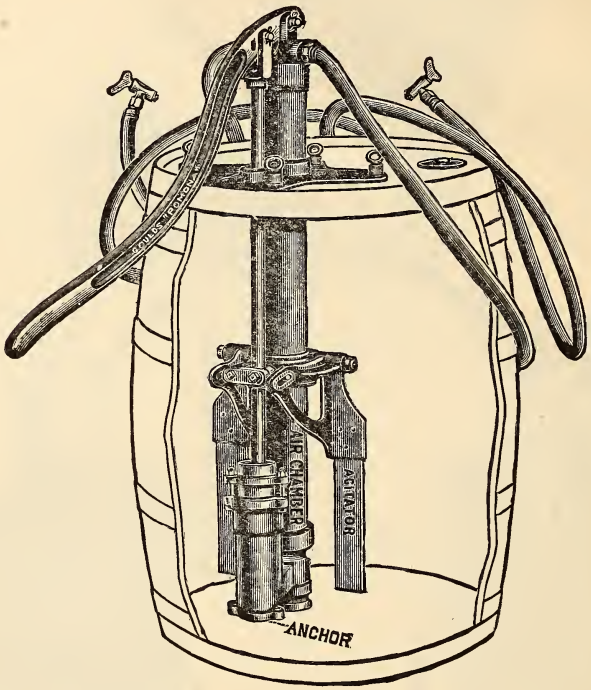


Fig. 4 Barrel Pump.

at either the side or end (preferably the side). In ordering this type of pump see that it is provided with a good agitator for keeping the spray mixture stirred while being used. The pump should be fitted so as to carry two leads of hose. Practically all manufacturers of spraying apparatus carry this type of pump. In our work we have found "The Spraymotor Jr., No. 2," made by the Spraymotor Co., of Buffalo, N. Y., entirely satisfactory. This particular pump, without hose or nozzle, costs $13 or $16.

Tank Sprayers. These differ from the barrel pumps mainly in their larger capacity and greater pressure. The "Planet," shown in Fig. 5, gives a general representation of the type. These pumps cost about $25.

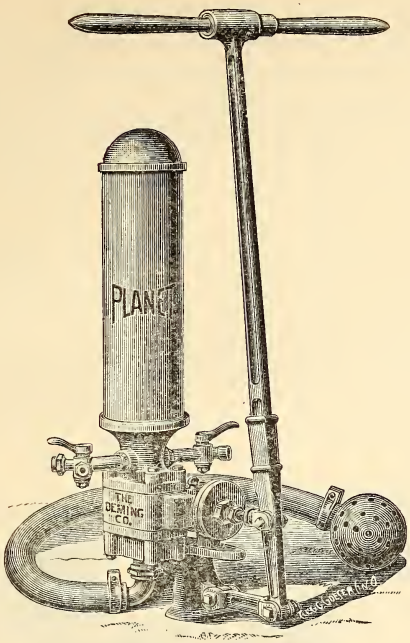


Fig. 5. Tank Sprayer.

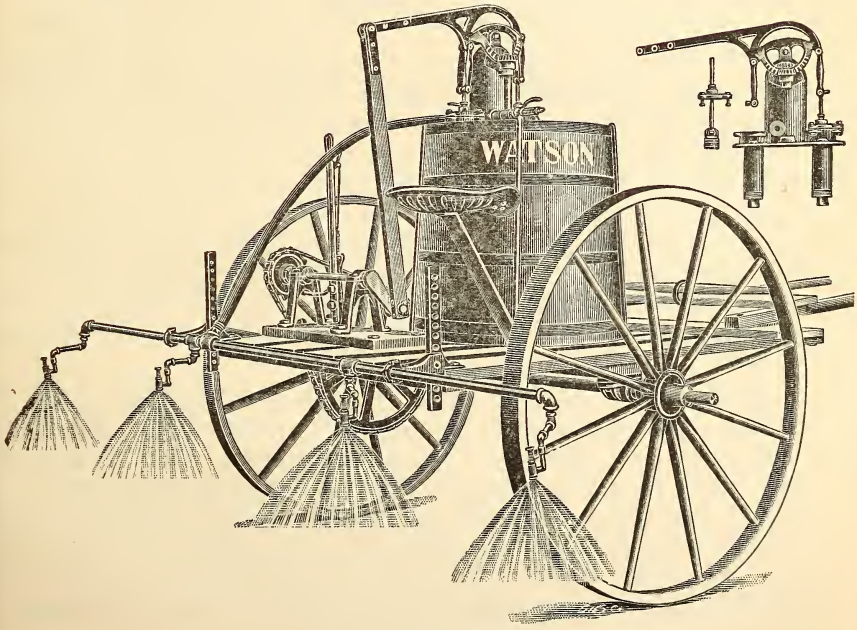


Fig. 6. Field Sprayer.

Field Sprayer. This sort of sprayer is used in spraying low plants, such as strawberries, potatoes, cabbage, etc. Several nozzles are attached, so that as many rows can be treated at one time. Where a number of acres of truck crops are grown, this type of sprayer might be used to advantage. The "Watson Sprayer," shown in Fig. 6, can be bought of Mr. Percy L. Banks, Norfolk, Va., who is agent for the Danforth Company.

Nozzle. The nozzle used should be one that will throw the liquid into a very fine spray—the finer the better. For accomplishing this, the Vermorel type of nozzle has not been excelled. In this type the liquid issues from the nozzle in the form of a cone-shaped mist which can be made so fine when the proper amount of power is applied that the nozzle must be used quite close to the part sprayed. To secure

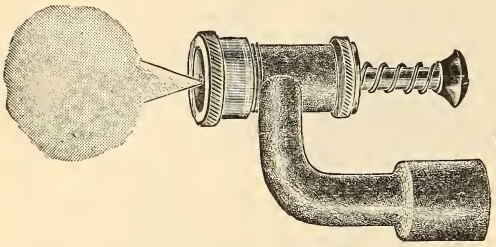


Fig. 7. Nozzle-Vermoral type.

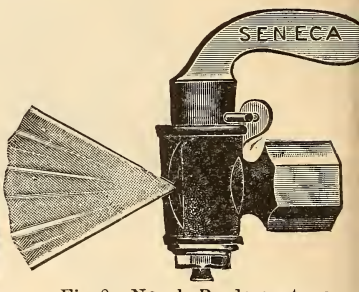


Fig. 8. Nozzle-Bordeaux type.

this in the case of tall trees the use of extension rods is necessary. These rods, which are usually made of three-eighth-inch iron tubing, from 6 to 12 feet in length, are attached to the hose at one end and the nozzle at the other. A second type of nozzle, the "Bordeaux," throws liquid in the form of a fan-shaped spray which is not so fine as that given by the Vermorel type. The Bordeaux type may be used to spray tall trees without the use of an extension rod, in which case the liquid issues from the nozzle in a fine stream which is not broken up into a spray until so caused by the action of the air. The resulting spray is not so fine as that secured by the Vermorel type of nozzle.

Hose. Good, durable hose, capable of standing about 125 pounds pressure, should be obtained. It is well to buy this, together with the nozzles and other necessary equipment, from the same concern where the pump is bought. In the case of the knapsack sprayer and bucket sprayer it is well to get seven or eight feet of extra hose. For use with the barrel and tank sprayer in orchards, 25 feet of hose is a satisfactory length. Hose can be obtained from 12 to 20 cents per foot, the price depending upon the kind and quality purchased.

Care of Spraying Apparatus. When the spraying has been completed, do not let the sprayer stand without first having exercised some sort of care. Some spray mixtures are very corrosive in character and should not be allowed to remain in contact with the machinery after the work is done, any more than smoke should be allowed to remain in a gun after the bullet has been fired. When you have finished spraying, dump out the liquid which is left in the tank, and then throw in three or four pails of clear water. After forcing this through the pump, hose and nozzle, wipe off the exposed parts with a cloth. *The farmer should exercise as much care with his spraying outfit as a hunter would with his gun.*

Dealers. Before ordering a spray pump write for catalogues of several of the different concerns dealing in spraying machinery. Examine these different catalogues carefully, then select that pump you think best suited to your needs. The following concerns are reliable dealers in spraying machinery:

Gould Manufacturing Co., Seneca Falls, N. Y.
Field Force Pump Co., Elmira, N. Y.
Sydnor Pump and Well Co., Richmond, Va.
Morrell & Morley, Benton Harbor, Mich.
Deming Co., Salem, Ohio.
E. C. Brown Co., Rochester, N. Y.
Spraymotor Co., Buffalo, N. Y., and London, Canada.
Rochester Spray Pump Co., Rochester, N. Y.
Friend Mfg. Co., Gasport, N. Y.
Hardie Spray Pump Mfg. Co., Detroit, Mich.
Wm. Stahl, Quincy, Ill.

EXAMPLES OF BENEFITS OF SPRAYING.

Spraying Protects the Foliage and Fruit from Insect and Fungous Attacks.—By properly spraying, perfect fruit and good yield are obtained where the omission of spraying would mean poor yield and diseased products, or permanent injury to the plant in the case of perennials.

A Marked Increase in Yield is often evident to even a casual observer. Where such is obtained by spraying there should be but little difficulty in securing recognition of the benefit from spraying.

Where the Increase in Yield is Slight, so slight as to require measuring to detect it, the benefit is often overlooked. Yet this slight benefit may turn a handsome profit upon the labor and materials invested in the spraying, and it is not to be ignored by the man who farms on business principles. To accurately judge the value of spraying, some portion of the crop should be left unsprayed, and the yield from sprayed and unsprayed fruits carefully noted and the differences compared with the cost of treatment. In the conduction of any large business every small increase in profit and every saving of leakage is important.

Perfection of Plant. The quality of the yield as well as the quantity is improved by spraying. Perfect fruit instead of imperfect fruit is harvested. With the prevalence of imperfect fruit on the market, the value of fruit of higher quality is often overlooked. The perfect product, however, proves its excellence on the market by its ready sale and the higher price it commands.

One cannot afford to raise inferior produce. The increase in quality, even if the quantity of the yield were not affected, is sufficient reason for spraying.

The Keeping Quality of many fruits grown for shipping manifests itself to the buyer and affects the price materially.

Protection of the Plant. In many cases the benefits are apparent the second and succeeding years rather than the first. Spraying protects the foliage that is accumulating nourishment for the crop the following year. If this foliage be protected from disease the crops of the future years receive the benefits. It is not only the yield of this year, but the future productivity of the plant that must be safe-guarded.

If a given plant or crop be raised for sale commercially, business principles demand that it be given that care which will give the greatest return for the money invested. It is now generally recognized by extensive growers of grapes, peaches, apples, potatoes, etc., that spraying pays. Spraying apparatus is as much a part of the equipment as is the plow, the harrow, or the knife. Spraying should be regarded

as insurance. It insures the crop against the devastation of disease; yet it differs from insurance in most cases in the fact that it pays for itself year by year even if there be no general epidemic.

A few quotations from various sources to illustrate the benefit of spraying are appended.

The result from spraying potatoes in the New York Experiment Station is stated as follows:

"The increase in yield per acre due to seven sprayings was 123½ bushels, having a value of $61.75; allowing that the extra expense of the seven sprayings was $13.00 per acre, there is left a net profit of $48.75 per acre."

"*Cost of Spraying Potatoes.*—Bordeaux mixture as we use it costs about 0.8 cents per gallon. The aim is to apply from one hundred and fifty to two hundred gallons per acre; if two applications are made, about three hundred gallons are used, while three applications require about five hundred gallons."

Fairly thorough spraying of potatoes can often be done at an expense of one dollar per acre for each application. At this rate three sprayings would cost three dollars. The returns that may be expected from such sprayings would be twenty-five to one hundred bushels per acre increase in yield. In most seasons the increase in yield will cover the expense of spraying, and in many seasons there will be a large net profit.

From a grape experiment in Ohio we quote:

"The average selling price of the other grapes, including baskets, was about ten cents per basket; the average return accordingly was was $125.21 per acre. This enormously increased return was secured here at a cost of $7.50 per acre."—*Ohio Bull. 130, p. 33.*

"While the unsprayed area yielded seven hundred and ninety-two pounds, or ninety-nine baskets of eight pounds each of inferior wine grapes, equal sprayed areas yielded a little more than three hundred baskets of fine grapes which brought $30.50, including baskets.

"The return per acre from unsprayed area is calculated at 316 baskets per acre, worth less than $10.00 per acre, while from the sprayed areas the average yield was 1,252 baskets per acre, worth $125.20 per acre."—*Ohio Bulletin 130, p. 46.*

PEAR SCAB.

"In New York (Geneva) in one case spraying at a total cost of 55 cents per tree increased the average yield per tree from 45 cents to $6.55," a net profit of $6.10 per tree.

APPLES.

"The sprayed portion yielded 534 sound apples or 4 bushels; and 48 wormy apples or about one-fourth bushel. The unsprayed portion yielded 216 sound apples or 1½ bushels; and 92 wormy apples or three-fourths bushel. Many wormy apples fell from the unsprayed portions during the season, and as this was not the case with the part sprayed, the above figures are very partial to the side that was not sprayed. The sprayed apples were larger, of better color, and showed less scab. The man who came to buy my crop saw the sprayed side of the tree first, and actually gave me five cents per barrel extra for all my fruit, although most of my orchard consisted of green instead of red apples."—*C. E. Chapman, Peruville, N. Y.; Bull. 60, Cornell Exp. Sta., p. 279.*

"Taking the average yield of the sprayed and unsprayed trees separately, we have the following results:

Northern Spy,	sprayed, average per tree.....	10.0	bu.
Baldwin,	sprayed, average per tree.....	8.5	bu.
Pearmain,	sprayed, average per tree.....	3.6	bu.
Baltimore,	sprayed, average per tree.....	7.0	bu.
Ohio Pippin,	sprayed, average per tree.....	6.6	bu.
Wells',	sprayed, average per tree.....	5.3	bu.
Grimes' Golden,	sprayed, average per tree.....	6.25	bu.

Northern Spy,	unsprayed, average per tree...	5.50	bu.
Baldwin,	unsprayed, average per tree...	3.25	bu.
Pearmin,	unsprayed, average per tree...	0.75	bu.
Baltimore,	unsprayed, average per tree...	3.5	bu.
Ohio Pippin,	unsprayed, average per tree...	0.5	bu.
Wells',	unsprayed, average per tree...	1.0	bu.
Grimes' Golden,	unsprayed, average per tree...	1.5	bu.

"The average per sprayed tree was 6.75 and of the unsprayed tree 2.42. Fifty sprayed trees produced 4.33 bushels of apples more per tree than the unsprayed, which was secured at a cost of not more than 20 cents per tree. In the case of the Northern Spy and the Baldwin, the actual profit derived from the treatment was more than five dollars per tree."—*Ohio Bull. No. 111, p. 114.*

"The following letter relates to the sale of apples from sprayed trees in Buffalo:

" 'The apples were as fine as anything I ever saw in the shape of Kings, even those rated as seconds or No. 2's being as good as the ordinary run of No. 1 fruit; in fact they sold at the price of other No. 1's. We commenced the trade on them as soon as they arrived

here to some of our buyers of fancy fruit at $4.50 per bbl. in job lots. I think had we put the price at five dollars we should have gotten it; in fact, we did get it for a portion of them, while the ordinary run of King's and so-called No. 1's sold in single barrel lots at the same time at $3.75 to $4.00. We think they went out fully $1.00 per barrel better than the average run of King's, and all who had them were anxious for more.'"—*J. H. Gail, Bulletin 60, Crn. Exp. Sta., p. 277.*

"From the records it appears that where the trees (plum) were sprayed, the average yield per tree of picked fruit was increased 44 per cent, the marketable drops increased 8 per cent, and the waste decreased 81 per cent. The total yield of marketable fruit as recorded in pounds was 45 per cent greater where the trees were sprayed than where they were not sprayed."—*N. Y. Agr. Exp. Sta. 15th Annual Rep. P., 400.*

From experiments at Tryon we have "the average weight of good grapes obtained from a vine in the unsprayed rows was 1 pound 1.5 ounces, as compared to 4 pounds 5.8 ounces from those given six sprayings with normal Bordeaux mixture, a difference of 4 pounds 4.3 ounces to the vine, or over a ton to the acre. This gain of a ton or more of grapes to the acre was due entirely to the six sprayings, at a cost of $15.42. In addition to this increased yield, the grapes could be picked at less cost, the trimming could be almost done away with, and in the end a product of far better quality commanding a higher price was obtained."

COST OF MATERIALS.

The material necessary for making the fungicides mentioned in this bulletin may usually be purchased with ease. If, however, your local dealer does not handle them, they may be obtained from any wholesale drug dealer by mail order. To give some idea of the approximate price and to suggest the address of a few dealers from given. It is possible that even better rates can be secured by correspondence.

W. H. King, wholesale druggist, Raleigh, N. C.

Copper sulfate	$0.10 per lb.
Copper carbonate 5-lb. lots	.35 " "
Ammonia 26°	1.00 per gal.
Potassium sulfide, 10-lb. cans	.20 per lb.
Flowers of sulfur, small lots	.10 " "
Flowers of sulfur, large lots	.06 " "

Formaldehyde solution 40 per cent, 5-pt. bottles, each	1.60	
Formaldehyde solution 40 per cent, 1-pt. bottles, each	.45	
Paris green	.25	per lb.
Pyrethrum	.25	" "
Whale-oil soap	.20	" "
Carbonate soda	.05	" "
Corrosive sublimate	1.25	" "
Crude carbolic acid	.40	per gal.
White arsenic	.20	per lb.
Arsenate soda	.30	" "
Acetate of lead	.25	" "
London purple	$0.25	per lb.
Commercial caustic soda, small lots	.10	" "
Commercial caustic soda, large lots	.08	" "
1-oz. bottle Formalin	.10	
2-oz. bottle Formalin	.15	
4-oz. bottle Formalin	.20	
8-oz. bottle Formalin	.30	
16-oz. bottle Formalin	.50	

W. H. King Drug Co.

Eimer & Armend, 205 to 211 3d Ave., New York City.

1 lb. copper sulfate	$0.10	
1 lb. copper carbonate	.35	
10 lbs. copper sulfate	.09	per lb.
1 lb. ammonia 26°	.15	
4 lbs. ammonia 26°, container extra	.12	per lb.
1 lb. commercial caustic soda	.15	
10 lbs. commercial caustic soda	.09	per lb.
1 lb. potassium sulfide, fused	.30	
10 lbs. potassium sulfide, fused	.25	per lb.
1 lb. flowers of sulfur	.10	
10 lbs. flowers of sulfur	.05	per lb.
1 lb. Formalin	.45	
10 lbs. Formalin	.40	per lb.
1 lb. Paris green	.20	
10 lbs. Paris green	.18	per lb.
1 lb. arsenate soda	.15	
10 lbs. arsenate soda	.12	per lb.
1 lb. acetate of lead	.15	
10 lbs. acetate of lead	.12	per lb.
1 lb. London purple	.20	
10 lbs. London purple	.18	per lb.
1 lb. Hellebore Po.	.25	
10 lbs. Hellebore Po.	.20	per lb.

1 lb. Pyrethrum	.40
10 lbs. Pyrethrum	.35 per lb.
1 lb. whale-oil soap	.12
10 lbs. whale-oil soap	.10 per lb.
1 lb. commercial white arsenic	.15
10 lbs. commercial white arsenic	.10 per lb.
1 lb. carbonate of soda (washing soda)	.02½
1 lb. corrosive sublimate	.95
10 lbs. corrosive sublimate	.90 per lb.
1 lb. crude carbolic acid	.10
1 gallon crude carbolic acid	.50

Merck & Company, University Place, New York City.

Copper sulfate, pure	$0.12 per lb.
Copper carbonate, pure	.35 " "
Ammonia 26°	.09 " "
Formaldehyde, in 1-lb. bottles	.35 " "
Sodium arsenate crystal	.17 " "

Arthur H. Thomas Co., S.W. Corner 12th and Walnut streets, Philadelphia, Pa.

	100 Lbs.	10 Lbs.
Copper sulfate	$7.00	$0.80
Copper carbonate	23.00	2.50
Commercial caustic soda (ground)	4.75	1.00
Potassium sulfate (ground)	8.00	1.00
Flowers of sulfur	4.00	.50
Formaldehyde 40 per cent, in carboys	19.95	2.00
Paris green	25.00	3.00
Arsenate of soda	18.00	2.00
Acetate of lead	13.00	1.50
Commercial white arsenic	7.00	.90
Carbonate of soda	2.50	.30
Corrosive sublimate	85.00	9.00
Whale-oil soap, 275 lbs.	14.00	1.60

Bulletin No. 194. **June, 1906.**

NORTH CAROLINA

Agricultural Experiment Station

OF THE

College of Agriculture and Mechanic Arts

RALEIGH

MULBERRIES.

THE NEW AMERICAN MULBERRY.

N. C. COLLEGE OF AGRICULTURE AND MECHANIC ARTS.

THE NORTH CAROLINA

AGRICULTURAL EXPERIMENT STATION

UNDER THE CONTROL OF THE

TRUSTEES OF THE A. AND M. COLLEGE.

S. L. PATTERSON, *ex officio* Chairman, Raleigh.

J. M. FOREHAND ..... Tyner.	A. T. MCCALLUM ..... Red Springs.
J. B. STOKES ..... Windsor.	J. P. MCRAE ..... Laurinburg.
WM. DUNN ..... Newbern.	R. L. DOUGHTON ..... Laurel Springs.
C. N. ALLEN ..... Auburn.	W. A. GRAHAM ..... Machpelah.
R. W. SCOTT ..... Melville.	A. CANNON ..... Horse Shoe.

STATION STAFF.

GEORGE T. WINSTON, L.L. D., President of the College.

B. W. KILGORE ..... Director.
W. A. WITHERS ..... Chemist.
C. W. BURKETT ..... Agriculturist.
TAIT BUTLER ..... Veterinarian.
F. L. STEVENS ..... Biologist.
H. H. HUME ..... Horticulturist.
J. S. JEFFREY ..... Poultryman.
R. S. WOGLUM ..... Acting Entomologist.
WM. KERR ..... Assistant in Field Experiments.
J. C. KENDALL ..... Assistant Dairy Husbandry.
O. L. BAGLEY ..... Assistant Chemist.
R. H. HARPER ..... Assistant Chemist.
F. C. REIMER ..... Assistant Horticulturist.
A. F. BOWEN ..... Bursar.

The Director's office is in the Agricultural Building, Raleigh: the experiment grounds and laboratories being at the Agricultural College, just west of town and on the street car line.

Visitors will be welcome at all times, and will be given every opportunity to inspect the work of the Station. Bulletins and Reports are mailed free to all residents of the State upon application.

Address all communications to

THE AGRICULTURAL EXPERIMENT STATION,
RALEIGH, N. C.

CONTENTS AND ILLUSTRATIONS.

CONTENTS.

ILLUSTRATIONS.

MULBERRIES.

BY H. HAROLD HUME AND F. C. REIMER.

INTRODUCTION.

Probably no fruit of equal importance from many standpoints, grown in America, has received so little attention from plant improvers and planters as the mulberry. Found here and there throughout the country in fence-corners and neglected spots, in poor uncultivated soil, it is true that the mulberry has had little opportunity to show the intrinsic merits which it unquestionably possesses. It is deserving of more and better attention than it has received heretofore, though it is doubtful whether it possesses any of the essential characteristics necessary to give it standing as a market fruit. With us any fruit which is not valuable for market purposes is likely to receive scant consideration. But on the other hand we must not lose sight of the fact that the mulberry can be grown easily, that it bears fruit profusely for a long period each year, and these points, coupled with the fact that it can be put to a goodly number of domestic uses, make it particularly valuable as a home or farmyard tree.

It thrives in all parts of North Carolina, and though we are not ready to recommend its extensive planting, still we do believe that every farm home should have a small number of trees.

Within recent years some attention has been given to the subject of silk culture,* and it is hoped and believed by some that eventually something in the way of a silk industry may be developed in this country. However that may be, we must not lose sight of the fact that in the development of any such industry, the primary requisite is the presence of a sufficient number of trees of the proper sort (Morus alba) within convenient reach from which to procure the necessary leaves for feeding the silk worms.

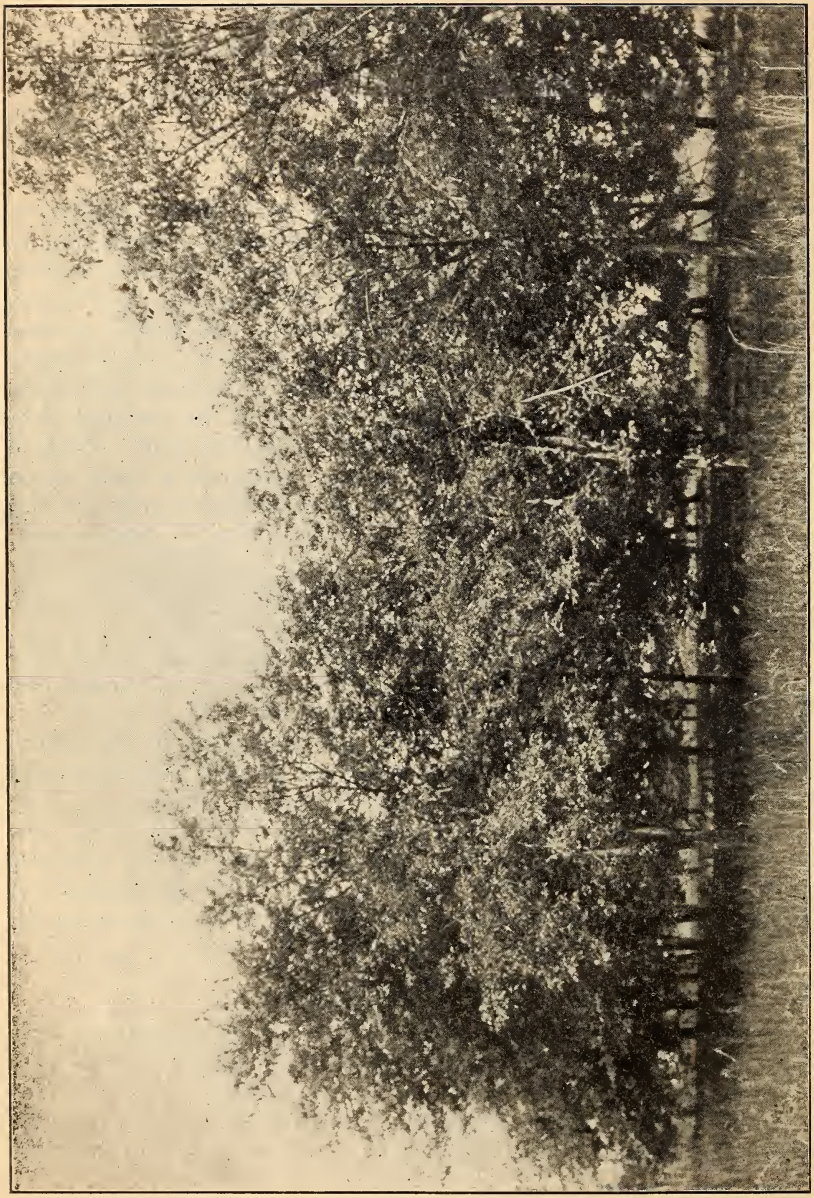
PROPAGATION.

The mulberry may be propagated from seeds or by grafting, budding, layers and cuttings. Of these methods the most important ones are by means of seeds, by grafting and by cuttings. These are the only ones which we deem it necessary to discuss, with the possible exception of sprig budding, which is in reality a method of grafting.

SEED PROPAGATION.

The mulberry can be easily propagated by seed. This method is used largely in propagating the mulberry when the tree is used for

*Those interested in this subject should procure a copy of Bulletin 181, N. C. Experiment Station, by Gerald McCarthy.



GROVE OF BLACK ENGLISH MULBERRIES, RALEIGH, N. C.

feeding silk worms in the silk industry. For this purpose the method does very well, as it is not important whether the seedling trees resemble the parent plant closely or not. Trees desired for hedges and ornamental purposes may also be grown in the same way, but when fruit is desired the best and most desirable kinds cannot be secured from seedling trees.

When gathering fruit to secure the seed, the best plan is to spread a large sheet under the tree and shake the fruit down upon it. The fruit should be mixed with a sufficient amount of water in a large tub or vat and thoroughly stirred so as to separate the seeds from the pulp. Running water should be provided if possible. Introduce the stream at one corner of the vat and allow it to flow through the box and out at the lower side, carrying with it the pulpy material as it is separated from the seed. The seed should then be dried and planted immediately or kept for future use. Seeds taken from early fruit may be planted at once. If seeds are to be held for planting the following spring, they should be thoroughly dried before storing, and kept in a cool, dry place.

Sowing the Seed.—The preparation of the land for mulberry seeds should be thorough. The ground should be well pulverized, mellow, deeply broken and sufficiently rich to give the seedlings a good start. It should contain a goodly quantity of vegetable matter to enable it to hold the necessary quantity of moisture. This needed vegetable matter may be secured by dressing the land with stable manure or by plowing under a crop of cowpeas or some other legume.

The rows should be laid off three and a half or four feet apart. Sow the seed thinly about two or two and a half inches deep. This work may be done by hand or a garden seed-drill may be used for the purpose.

In North Carolina, generally speaking, the seed may be sown between the latter part of March and the latter part of May. Seed that has been held over from the previous season will not germinate so rapidly as the newly-extracted seed, and for this reason should be planted as early as possible. Taking the State as a whole, the best date would be about April 15th. Seed freshly extracted cannot be secured until the middle of May, but may be sown then with good results, provided the weather conditons are right.

PROPAGATION BY CUTTINGS.

Most species of mulberries are easily propagated by means of cuttings. And while the most satisfactory and most economical plan is to use one-year-old branches for this work, twigs of the current season's growth may also be used.

Cutting wood may be removed from the trees soon after the leaves have dropped. Select well-matured, well-developed one-year-old

branches from one quarter to five-eighths inches in diameter. Cut these into pieces, each being provided with from three to six good buds. The length of the pieces will vary somewhat, from eight to ten inches is about right, but before planting it is best to divide them into bunches, each bunch being composed of those of nearly equal length. The upper cut should be made a half inch above a bud, and a very sharp knife should be used to insure a perfectly smooth cut. Smooth cuts will callus over much more rapidly than ragged ones. Before planting, it is sometimes desirable to split the lower ends of the cuttings an inch or two and spread them slightly, thus giving a larger surface to callus over. This often results in a much stronger root system and consequently more vigorous growth during the season.

In eastern North Carolina the cuttings may be planted immediately after removal from the trees; but in the colder sections it is usually best to tie them together in bunches of twenty-five and store them in damp sand in a cellar or pit until spring. The bundles should be entirely buried, and by spring it will be found that the wounds have callused, and in some cases tiny roots will have started. A good plan for storing is to pack them on end in sand, covering them about half way up and then covering over the tops with damp sphagnum moss.

The ground in which the cuttings are to be set should be well plowed and pulverized thoroughly, then rolled. The earth, if in good mechanical condition, may be opened for the cuttings by simply thrusting a spade down into it, along the line from one end of the area to the other, at each thrust shoving the spade a little to one side to make an opening. Into the opening thus made thrust the lower ends of the cuttings, leaving only one bud above the surface, and pack the earth tightly back in place with the feet. Or, a furrow may be thrown out with a plow and the cuttings covered up to the top bud by plowing a second furrow back against them, packing the earth against them as already indicated. Planting should be followed with a cultivation with a light cultivator to provide a surface mulch of dry earth.

PROPAGATION BY BUDDING AND GRAFTING.

Mulberry trees cannot be propagated as cheaply by budding and grafting as by seeds and cuttings, but seeds will not give trees like those from which the seed was gathered, and cuttings will not make large-sized trees quickly enough in many cases. Hence, to get good-sized trees in a comparatively short time and of known parentage, budding or grafting must be done. The common methods used in propagating the mulberry are sprig or scion-budding and whip, cleft and saddle-grafting. All the methods of grafting mentioned may be

used indoors, *i. e.,* bench-grafting; while the first two, viz., whip and cleft-grafting, are the only ones which can be conveniently used for outdoor work.

STOCKS.

In the North and West, Russian mulberry seedlings are used for stocks, while by many Southern nurserymen *Multicaulis* mulberry stem or root cuttings are used almost entirely. Whether Russian mulberry seedlings would or would not be superior to *Multicaulis* cuttings or seedlings, we are unable to say, as experimental knowledge is lacking on this point; but in the longer-growing season of the South it is a fact that in some parts the trees, even when grown on root cuttings, reach such a size in a single season as to make them unsalable. Under such conditions they should be grown only from cuttings.

WAXES AND WAXED CLOTH.

Grafting Wax.—Good grafting wax may be made from resin, beeswax and tallow or linseed oil. A large number of formulas have been used, but the following are good and may be taken as representative:

1. Resin, 6 pounds; beeswax, 2 pounds; linseed oil, 1 pint.
2. Resin, 4 pounds; beeswax, 2 pounds; tallow, 1 pound.

Melt the ingredients of either formula in an iron kettle over a slow fire. Stir as they melt, to insure thorough mixing. Pour out into a bucket of cold water, grease the hands and pull until it becomes straw-colored. Wax not intended for immediate use may be rolled up in greased paper and put away. Grease the hands a little in using the wax.

Waxed Cloth.—Melt a sufficient amount of the wax in a kettle. Into it dip narrow sheets of old calico or cambric. As soon as saturated with the wax take them out, stretch and allow to cool. For use tear into strips about one-half inch wide.

Waxed Twine.—Melt the wax as above, and into it drop balls of No. 18 knitting cotton. Stir them about in the wax for about five minutes, by which time the wax will have penetrated them. Then take them out and allow them to cool. The twine will break easily without injuring the fingers.

SPRIG BUDDING.

This method may be used in propagating the mulberry. It was probably first extensively used by S. D. Willard, Geneva, N. Y.

The scions should be cut in autumn as in the making of cuttings, and held over until time for inserting in spring after the leaves have

started, and the bark separates readily from the wood. Use small-sized, well-matured shoots with two or three well-developed buds. Prepare the scions for inserting in the stocks by making a smooth, sloping cut on the lower end. This cut should be an inch or an inch and a quarter in length.

The stock is prepared for the scion as in ordinary shield-budding by making two cuts in the shape of the letter T on its side, close to the ground where the scion is to be inserted. Carefully lift the edge back and insert the scion, shoving it well down into place. Then wrap with waxed cloth or twine and cover the point of union with grafting wax.

In from ten days to two weeks the parts will have united, provided the operation is successful. At this time the stock should be lopped or its top should be cut back to divert a larger portion of the sap to the scion, thus forcing it into growth.

WHIP GRAFTING.

For this work either a whole seedling root or a piece of a root may be used as a stock. On account of the spongy nature of the mulberry root it is best to use the whole root, making the insertion at or in the solid part of the stem just at the ground. In the warmer parts of the State the stocks may be taken from the ground as desired for use, but in the colder sections, where the ground is more or less frozen during winter, they should be lifted in autumn after they have become dormant and stored until needed in February and March. The scions should be procured about the same time and carefully stored.

In preparing the stock cut off the tops and at the crown or on the root at the desired point, as the case may be, make a sloping cut one and a quarter inches long. On the scion (cut to a length of six or eight inches with a bud within a half inch of the upper end) make a corresponding oblique cut. On both stock and scion raise a tongue of wood and then shove the two pieces together, taking care that the cambium layers along one side at least are in contact. Then wrap with waxed cloth.

In eastern North Carolina these may be planted out immediately, but in the western sections it is best to tie them in bundles of twenty-five, and store as directed for cuttings, until time for planting arrives.

CLEFT AND SADDLE GRAFTING.

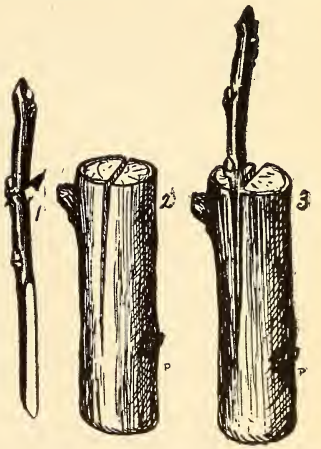
SADDLE GRAFT.
(From author's Bulletin for January, 1906.)

Both these methods are well adapted for the propagation of the mulberry, and may be used either for whole stocks or for piece roots, or stem-cuttings.

The scions and stocks should be procured in late autumn and stored until February, as directed under whip grafting.

Cut the scions six or eight inches in length. For cleft grafting, trim the lower ends to a wedge, with sloping cuts one inch in length, and for saddle grafting split the scions one inch up from the lower end.

Prepare the stocks for cleft grafting by splitting them down one inch, and for saddle grafting by trimming to



CLEFT GRAFT.
(From author's Bulletin of Department of Agriculture, January, 1906.)

a wedge to fit the split ends of the scions. In both methods place the stocks and scions together with the cambium layers in contact, wrap and treat as directed under whip grafting.

SOILS.

No tree will thrive on a greater variety of soils than the mulberry. In fact, it seems to be indifferent as to the kind of soil. In North Carolina it can be grown successfully on the sandy soils of the coast

region, the sand hill section, the heavy clays of the Piedmont, and the clays and rocky soils of the mountains. The soil need not be rich, must not be too wet, but should be rather moist. It flourishes best on the moist, sandy loams of the eastern part of the State.

PLANTING.

The planting can be done either in fall or spring. In Western North Carolina the best time for planting is during the month of March, while in the eastern sections late November to January is probably the best season. The distance apart should be varied for the different kinds. Large trees—like New American, White English and Black English—should be planted not less than thirty feet apart; and those belonging to the American species (*M. rubra*)—like Stubbs and Hicks, should be planted thirty-five feet apart. The varieties belonging to the Russian group are usually smaller and need not be planted more than from twenty to thirty feet apart.

The planting does not require any special skill or care. The trees will usually live even under the most adverse conditions. Dig the hole large enough to receive the roots, and deep enough so that the tree will stand slightly deeper than it did in the nursery row. As nursery trees are usually large they should be heavily cut back; say to a height of three feet. The long roots are much broken in digging the trees, and should be well trimmed before setting.

CULTIVATION.

The mulberry needs little or no cultivation. When planted in chicken yards or where hogs are allowed to run and root, no extra cultivation need be given. They will thrive in soddy land; but generally the trees do better where the soil is stirred or worked, as in hog pastures. If any cultivation is given it should be shallow, as the roots spread out near the surface of the ground. Deep plowing should not be practiced.

PRUNING.

The mulberry requires little or no pruning. But as the wood is rather brittle and the branches are easily broken by sleet storms, the stubs which are left should be cut off close up to the trunk and the broken branches cut smoothly off at the ends; all large wounds should be covered with paint. The Black English variety has a tendency to grow tall and upright; this can be overcome by cutting it back while the tree is young. Some varieties form very thick heads, which could be thinned out to advantage. Long roots should be cut back when planting.

VARIETIES.

The number of varieties of mulberries brought forward is not large. Of these a number have been added quite recently, and it is very probable that the list will be increased from year to year. Most of these are seedlings which have attracted attention in different regions because of merits which they possess. Undoubtedly there are many varieties in the country not now advertised or propagated by nurserymen which are equal or superior to many of our named varieties. This is but a natural result of the planting of a large number of seedling trees.

The nomenclature of the mulberries is badly mixed, and it is impossible to trace some of the varieties back to their origin.

We have endeavored to classify all the varieties now catalogued or grown in the South, according to the species from which they have been derived. This system of classification was first used by Professor L. H. Bailey.

In one or two instances it has been very difficult to say in which group a certain variety belongs. In some instances they appear to grade into each other in such a way as to suggest a hybrid origin. This is particularly true of the Black English now grown in North Carolina. We have placed it in the Morus alba group, but it shows some characteristics of our native mulberry Morus rubra, and it is in all probability a cross between the two species just named.

In planting mulberries for fruit in this State the following varieties should be given preference:

Black-fruited: New American, Black English, Stubbs and Townsend. White-fruited: White English and White Russian.

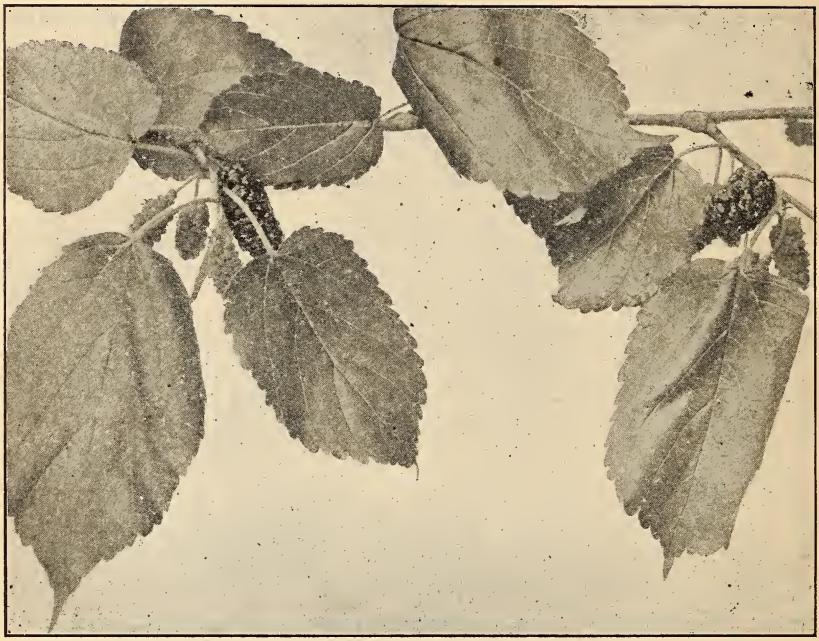
The New American is a large-fruited, prolific variety. The fruit is sub-acid and of excellent quality.

Black English is a strong upright grower, which bears a large amount of fruit of medium size for a long period. This is one of the most satisfactory varieties catalogued by North Carolina nurserymen.

Stubbs. This is a wide-spreading, vigorous, large-fruited and prolific variety. The fruit is strongly sub-acid, and the largest variety known to the writers.

Townsend. This is probably the earliest fruiting variety now grown. While it has not been grown in this State, we believe that it should be introduced. It would lengthen the mulberry season considerably.

White English. It is a very heavy bearer, producing sweet, medium-sized fruit for many weeks. This is by far the best white-fruited mulberry that we have seen.



BLACK ENGLISH (ONE-HALF SIZE).

DESCRIPTION OF VARIETIES.

Varieties Derived from *Morus alba.*

This species is probably a native of China, and has been cultivated for centuries in the Old World for feeding silk worms. It was introduced into this country early in the last century and now is often found wild throughout a large portion of the eastern part of the United States.

The tree is a large, vigorous, upright grower, with medium-sized, ovate or oblong leaves which have a smooth, shiny surface and are light green in color. The teeth on the margin are usually large and rounded.

The fruit of the original form of this species is white or violet; but a number of black-fruited varieties have also been produced.

Black English. Fruit—Form oblong, slightly curved; medium to large, ¾ x ⅜ to ¾ x ½ inch; reddish, becoming black when fully ripe; apex rounded; base oblique and irregular; stem ½ inch long, slender; druplets variable, flat to circular in outline, compacted and firm; sutures rather shallow and narrow, flavor sweetish; quality only fair. Season, May to July.

Leaves—Ovate to oblong elliptical, regular; apex long acuminate; base rounded or slightly cordate or nearly truncate; leaves on young growth four to five lobed, sinuses deep and rounded; size variable, average 3¼ x 2½ inches; surface smooth above, rough beneath, finely pubescent along the veins; color dull green above and light green below; margin regular, strongly serrate, sometimes serrate dentate; petiole 1 to 1½ inches, stout, veins prominent, white; pubescence well marked on veins and very fine over entire under surface.

Tree—Large, vigorous grower; strongly upright in habit, branches with a stripped habit; heavy and continuous bearer. Much grown in North Carolina. Specimens obtained from J. Van Lindley, Pomona, N. C.

New American. Fruit—Form oblong, slightly curved and somewhat irregular in large specimens. Size, very large—1½ x ½ to 1¾ x 8-16 inch; color, shining black when ripe; apex blunt and rounded; base oblique and irregular; stem stout and short, ⅜ inch; druplets medium in size, flattened, irregular, compact, smooth; sutures rather shallow and narrow; flavor very sweet; quality good. Season, May to July.

Leaves—Ovate to oblong, often somewhat rhombic on young growth. The leaves are two to four lobed, sinuses rather shallow and acute; apex long acuminate; base truncate; size 2 x 1½ to 4¼ x 2½ inches; thick, leathery, smooth upper surface, lower surface slightly rough; color dark green, shiny; margin serrate dentate, teeth rounded; veins prominent, whitish, no pubescence.

Tree—A large, vigorous, hardy tree. A heavy and continuous bearer. Introduced about 1854 by N. H. Lindley, of Bridgeport, Conn. Very widely grown and considered the best variety now in cultivation. Specimens received from J. Van Lindley, Pomona, N. C. Especially adapted to the cold mountain climate.

Westbrook (Westbrook Choice) (*Black English*). Fruit—Form oblong, slightly curved; size medium—$\frac{3}{4}$ x 5-16 to 13-16 x $\frac{3}{8}$ inch; color reddish, becoming black; apex rounded; base oblique; stem short, 5-16 to $\frac{3}{8}$ inch, slender; druplets variable, oblong to roundish in outline, loosely compacted; sutures of medium depth and rather narrow; flavor sweet, pleasant; quality good. Season, May to July.

Leaves—Shape oblong, pointed; apex long acuminate, base truncate or slightly cordate; rather small—$1\frac{1}{2}$ x $1\frac{1}{2}$ to 4 x 2 inches; aver-

WESTBROOK (BLACK ENGLISH).

age 3 x 2 inches; character thin, smooth above, slightly rough beneath; pubescent on larger veins; color shining, light green above, light yellowish green beneath; margin serrate, well marked, regular; petiole short, $\frac{3}{4}$ inch, medium stout; veins prominent, whitish, pubescent on large veins.

Tree—Of medium size and vigor, heavy fruiter. This is simply a selected strain of Black English. A good variety for poultry and swine. Much like Black English. Specimens obtained from J. Van Lindley, Pomona, N. C.

White English. Fruit—Form oblong, curved; size medium—$\frac{5}{8}$ x $\frac{3}{8}$ to 13-16 x 7-16 inch; color whitish, turning brownish as it becomes over-ripe; apex rounded, base rounded or oblique; stem long, $\frac{1}{2}$ to $\frac{5}{8}$ inch, slender, curved; druplets flattened, narrow, compacted, medium in size; styles very prominent on ripe fruit; sutures narrow and fairly deep; flavor sweet; of good quality. Season, May to July.

WHITE ENGLISH.

Leaves—Oblong, elliptical, some leaves nearly rhombic, young leaves two to five lobed, sinuses shallow and rounded; apex with long acuminate point; base slightly cordate; average size $3\frac{1}{2}$ x 2 inches; medium, thick, upper surface smooth, lower surface smooth and somewhat pubescent; upper surface dark green; lower surface yellowish green; margin strongly serrate, dentate; petiole short, slightly curved; veins very prominent on lower side, whitish; pubescent only in the axils of veins.

Tree—With a distinct spreading, sprawling habit. Very vigorous. Bark on larger branches with distinct brownish, irregular, cracked streaks. The fruit is very sweet and pleasant. Specimens for description obtained from J. Van Lindley, Pomona, N. C.

Varieties Derived from *Morus alba var Tartarica.*

This is a sub-species of the White Mulberry group. It was introduced into the West by Russian Mennonites about 1875, and has

proved itself well adapted to that rigorous climate; it is undoubtedly our hardiest mulberry. As it is usually propagated from seed, it is very variable.

The tree is small and bushy, usually with a drooping habit. It is much used as a stock where extreme hardiness is necessary. The fruit, like that of its parent, the White Mulberry, is variable in color and size. Most varieties of it are white or violet in color and more rounded in form than those of other species. Some forms of it are much used for ornamental purposes.

Abundance. Same as Barnes.

Barnes. Fruit—Cylindrical, somewhat curved; size medium—$\frac{3}{4}$ x $\frac{3}{8}$ to 1 x $\frac{1}{2}$ inch; color black, when fully ripe; apex rounded; base irregular and oblique; druplets large, ovate to roundish in outline, compact; styles present but not conspicuous; sutures shallow and narrow; stem short and thin, and deeply imbedded; flavor slightly sub-acid, but very sweet when fully ripe; quality fair. Season, May and June.

Leaves—Ovate to oblong ovate; apex rounded or sometimes acute; base truncate, often oblique; size medium—$2\frac{1}{2}$ x $1\frac{3}{4}$ inches; thin and smooth; dark green in color; margin serrate-dentate; veins distinct but not prominent.

This variety was introduced about ten years ago by John Frasier, of Huntsville, Ala., who secured it from a neighbor as a Russian seedling. It has also been advertised recently under the name "Abundance."

Black Russian (*Russian*). Fruit—Short oval to oblong; size medium—$\frac{3}{4}$ x $\frac{1}{2}$ to 1 x $\frac{1}{2}$ inches; black when ripe; apex blunt, obtuse; base oblique, somewhat irregular; stem short, small—$\frac{1}{4}$ to $\frac{3}{8}$ inch long; druplets large, broad and rounded, irregular, rather compact; sutures deep and open; flavor sweet, slightly sub-acid; quality good. Season, May to June.

Leaves—Ovate, often oblong-ovate; size medium—$3\frac{1}{4}$ x 2 to $4\frac{1}{2}$ x 3 inches; thin, leathery, smooth above, rough below; dark green in color; margin irregular, singly or doubly dentate-serrate, teeth large and rounded; young leaves strongly lobed; veins prominent, whitish; and rounded; young leaves strongly lobed; veins prominent, whitish; pubescent along veins on under side.

Tree—Small, rapid grower, hardy. Early and heavy bearer. One of the many Russian seedlings. Obtained from John Young, Greensboro, N. C.

The three following varieties are not grown in the State so far as we know, and have not been seen by the writers. We do not know what class the Monark belongs to, but have placed it here because

BLACK RUSSIAN.

it originated in that part of the West from which most of our Russian varieties have come.

Monarch. This is a white-fruited variety, advertised by Stark Bros., Louisiana, Mo., who secured it from Mr. E. H. Riehl, of North Alton, Ill. A chance seedling which came up at Mr. Riehl's place about forty years ago. It is said to be a very vigorous grower. The original tree is said to be over 60 feet high, with trunk over nine feet in diameter.

Munson. Originated by T. V. Munson, of Denison, Texas, from a seedling of the Russian. Said to be one of the best Russians.

Ramsey. A white-fruited mulberry of Russian parentage. Not highly prized. Introduced about 1880 by Ramsey & Son, of Mohamet, Texas.

Victoria. Fruit oblong or cylindrical; size small—7-10 x $\frac{3}{8}$ inch; color black; base and apex rounded; druplets usually flattened, oblong, medium in size; sutures shallow and narrow; flavor sweet, insipid; of poor quality. Season, May to June.

Leaves—Ovate, lopsided; small—2 x $1\frac{1}{2}$ inches; margin with large rounded teeth; surface smooth; thin blade; color dark green. Specimens for description obtained from G. Onderdonk, Nursery, Texas. Introduced by G. Onderdonk in 1883. Said to be one of the best varieties in Texas.

WHITE RUSSIAN.

White Russian. Fruit—Form variable, from oval to oblong, plump; medium in size—$\frac{3}{4}$ x $\frac{5}{8}$ inch; color white, and ends of druplets purplish, becoming deep purple when over-ripe; base and apex rounded and regular; stem medium, stout and long, 7-16 inch, curved; druplets large oval or roundish in shape, loosely compacted; sutures deep and open; flavor very sweet and rather flat; quality fair. Season, May to June.

Leaves—Ovate to oblong, usually lopsided, leaves on young growth

deeply three to five-lobed; apex short—obtuse or rounded; base obliquely truncate; blade rather small—$1\frac{1}{2}$ x $1\frac{3}{8}$ to $3\frac{1}{2}$ x $2\frac{1}{2}$ inches; color dark green on upper side, yellowish green on lower side; thin, smooth on both sides; margin prominently serrate-dentate, teeth strongly rounded; and short; petiole $1\frac{1}{2}$ to $2\frac{1}{4}$ inches, stout, curved; veins very prominent on under side; whitish yellow in color; tufts of pubescence in axils of veins on lower side.

Tree—Small, bushy and very hardy; quite productive. One of the Russian seedlings from Kansas. Will probably become a desirable new variety. Specimens obtained from J. Van Lindley, Pomona, N. C.

NATIVE RED MULBERRY.

Varieties Derived from *Morus rubra.*

This species is a native of this country, and is very widely distributed, being abundant from the extreme north to the Gulf of Mexico. It is a very hardy and vigorous tree, and from it several important varieties have sprung.

Its leaves are large and rough, and those on vigorous shoots are usually much-lobed. The fruit varies considerably, but usually is reddish or black in color and of good, sub-acid flavor. On the wild forms the fruit is usually of medium size, but some of the varieties which have sprung from it have very large fruit of good quality.

HICKS.

Hicks. Fruit—oblong, straight or curved; medium to large in size—$\frac{3}{4}$ x $\frac{1}{2}$ to $1\frac{1}{4}$ x $\frac{1}{2}$ inch; color reddish, becoming black; apex rounded, base oblique or rounded; druplets compacted, flattened, medium; styles inconspicuous; sutures narrow and shallow; stem $\frac{1}{2}$ inch long, slender, deeply imbedded in fruit, pubescent; flavor sweetish, insipid; ;quality poor. Season, June to July.

Leaves—Ovate, apex variable, rounded and blunt to long acuminate, often-lobed; leaves on young growth deeply four to six-lobed, with deep and rounded sinuses; base truncate or rounded and cordate; very large—3 x 4 to 6 x $4\frac{1}{2}$ inches; blade thin, rough, thickly pubescent beneath; dull green in color, lighter green beneath; margin strongly serrate, teeth large; veins large and prominent; light yellowish, white beneath; pubescent beneath, especially on the veins.

Tree—Large, vigorous grower; very heavy, continuous bearer. Originated at Macon, Ga. Introduced about 1850 by Simri Rose. Good for swine and poultry; too poor flavor for eating purposes. Obtained from G. L. Taber, Glen St. Mary, Fla., and J. Van Lindley, Pomona, N. C.

STUBBS.

Stubbs. Fruit—Form oblong, curved and slightly irregular; very large—$1\frac{1}{2}$ x $\frac{1}{2}$ to 2 x $\frac{5}{8}$ inches; color bright, deep red, becoming black; apex rounded, base usually oblique and somewhat irregular; druplets compacted, flattened, medium in size; syles present; sutures shallow and narrow; flavor sub-acid; vinous, sharp; quality good. Season, June to August.

Leaves—Ovate, somewhat variable, often two to three-lobed, sinuses deep and narrow, apex abrupt; base truncate or oblique; size 4 x 3 inches, thick, smooth above, rough beneath; dark green color; margin irregular, often broken, teeth variable, large, singly or doubly serrate. Veins very prominent, white; pubescent on under side.

Tree—Very large and vigorous; very prolific. Originated near Duplin, Ga. Mr. P. J. Berckmans introduced it about 1887. Specimens from G. L. Taber, Glen St. Mary, Fla.

Townsend. Size medium—1 inch by ½ inch; oblong, slightly curved; black; rounded at both base and apex; druplets long and narrow, 3-16 by 1-16, not permanent; sutures rather shallow; flavor sweetish, not differing from other mulberries. Season early; ripening at Glen St. Mary during the latter part of March and the month of April.

Leaves—Ovate in shape; apex short, with short acuminate point; base cordate, often unequal; size medium to large—4½ x 3 to 5½ x 4 inches; surface even, slightly rough; lower surface rather smooth; color shining dark yellowish green; margin regular, sharply serrate; veins prominent, whitish; pubescence only along the veins; petiole stout, 1 to 1¼ inches long.

Prolific trees fruiting abundantly in the nursery row one year from grafting. Original scions obtained by Mr. G. L. Taber from Mr. Andrew Townsend, Glen St. Mary, Fla., in 1903.

The fact that this mulberry ripens so much ahead of other varieties in North Florida, a characteristic which it will retain, doubtless, in other parts, should give this fruit a prominent place among the varieties of this fruit.

Varieties Derived from *Morus latifolia.*

This was the most important species during the silk industry craze of 1830-'39. It is a native of China, and was introduced into America from France about 1826. It is a vigorous grower, but never attains a very large size. The leaves are very large, rough, and dull in color. The fruit is black and sweet. This species has given rise to one important variety—the Downing—which has practically disappeared from cultivation. It has been supplanted by the New American, which is a much better variety; this latter variety is often sold under the name Downing. This species is used almost entirely in the South as a stock for the other species of mulberries.

The Black Mulberry (*Morus nigra, Linn*). This is the species cultivated in Europe for its fruit. It is almost unknown in this country at the present time. About fifteen years ago the Black Persian, a variety belonging to this species, was cultivated in parts of the South; but at present no nurseryman in the South catalogues it, so far as we know. The P. J. Berckmans Company, of Augusta,

Ga., writes us as follows, regarding this variety: "We used to cultivate the Black Persian Mulberry years ago, but we have lost it. It makes a very dwarf growth, and is unsatisfactory here."

USES.

The mulberry has not been put to many uses, and has not been as extensively used as its merits indicate. The fruit of the best varieties is very good when eaten fresh. Some of the varieties ripen their fruit over a period of several months, which is not true of any other fruit. It can also be used for pies, and jellies, and those who have used them say that they are quite good.

The tree is a rapid grower and makes a splendid shade tree, especially around stables and stock yards.

No better fruit is known for swine and chickens than the mulberry. Some trees produce as high as ten or twelve bushels of fruit, and during the long fruiting period, pigs and chickens need little other food. They also grow well in hog pastures and chicken yards, and give excellent shade.

They serve an excellent purpose near cherry trees and on strawberry plantations in attracting birds away from these fruits. As long as there are ripe mulberries close at hand, the other fruit will suffer very little from birds.